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Edited by H. H. Brown, A. M. Inst. N. A.
Member Soc. N. A. and M. E.

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Lake Traffic Monopoly Ended

Important results are expected by shipping interests from the recent decision of the Interstate Commerce Commission, which separates the steamship lines on the Great Lakes from the railroads which have hitherto owned and operated them. The decision goes into effect on December 1, 1915, and is based on the Panama Canal Act forbidding railroad ownership of competing water lines except where it can be shown that public convenience and necessity are served by such control. The lines which are directly affected by this decision have been the means of stifling competition in waterborne traffic on the Great Lakes through rate schedules devised by the railroad companies that have controlled the steamship lines. A monopoly of lake transportation has thus been created and traffic between the lake lines and the canal barge lines operating on the Erie Canal has practically ceased, to the injury of both carriers. With independent steamship lines on the Great Lakes, free to operate in conjunction with the canal barge lines, a through water route will be furnished from the western lake ports to the eastern seaboard, and it is anticipated that this arrangement will prove advantageous to the interests of both carriers. If these expectations are realized, not only will the value of the Erie Canal be enhanced but the usefulness of the new State Barge Canal when completed will be insured and a large volume of traffic will be diverted to this important thoroughfare.

The Shipbuilding Boom in the United States

Owing to the present war conditions, prices of steel used for shipbuilding in Europe have reached a point very materially higher than that for which steel is sold for shipbuilding in the United States. When to this increased cost of material is added the large increase in wages that now prevails in British and continental shipyards, the cost of building ships abroad will be found to be higher than it is in the United States. Furthermore, practically all of the British and continental shipyards are occupied very largely, if not wholly, with naval work, so that very few orders are being placed with them for new merchant vessels. With the existing tonnage in Europe decreasing at an abnormal rate it is only natural that shipowners in Great Britain, Spain, Portugal, Germany, France, Russia, Denmark, China and other countries are inquiring as to the possibilities of having vessels built in the United States, especially as the demand for tonnage for handling the increase of ocean traffic after the war is over will be urgent. In the meantime, nearly every steamship company flying the American flag is looking for new vessels. Among these are the Ward Line, the Union Sulphur Company, the Gulf Refining Company, the Luckenbach Steamship Company and the Clyde Line, all of New York, the Matson Navigation Company of San Francisco, the Merchants' & Miners' Transportation Company of Baltimore, and other companies. As a matter of fact, at the present time there are few American shipyards that can contract for the delivery of a ship of any size inside of twenty to twenty-four months. With all the business in hand and in sight, the majority of American shipyards have all the work that they can possibly handle for at least five years to come.

Growing Importance of the American Merchant Marine

According to figures supplied by the Department of Commerce, from July 1, 1914, to May 1, 1915, there were 877 merchant vessels of 179,450 gross tons built and officially numbered in the United States. These, added to 142 foreign-built vessels of 500,705 gross tons admitted to American registry under the Act of August 18, 1914, give a total increase in the American merchant marine of 1,019 vessels of 680,155 gross tons for the past ten months, which is considerably larger than the increase of any previous year. During the fiscal year ended June 30, 1907, the new tonnage added to American registry was 596,708 gross tons, and until that year the record was held by the fiscal year of 1855, with 586,102 gross tons. Considering the fact that the American merchant marine is the third largest in the world, its present rate of increase is very encouraging to shipowners and shipbuilders. Especially is this so as heretofore American ships were confined almost wholly to domestic trade, whereas now they are beginning to share to a limited extent in the overseas trade, with the likelihood that as the importance of this factor to the permanent welfare of the country becomes more fully recognized the public at large will be led to foster the shipping and shipbuilding

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industries, rather than to hinder and restrict them as in the past. With better prospects at hand for the shipbuilding industry, there will also result a very great economic advantage for American shipyards, for the reason that steady employment, with opportunities for advancement, can be offered to their employees, thereby giving the opportunity to perfect shipyard organizations to a state of efficiency in economy and excellence of production that hitherto has been impossible on account of the lack of steady employment and advancement for the men who have been trained in this special work.

Dredges and Dredging Operations

The proper selection of a dredge for any particular service depends upon a great many factors, and, as the physical characteristics of various harbors and waterways differ widely, no standard dredging equipment can be said to apply to every class of work. In Europe the prevailing types of dredges commonly used for harbor and reclamation work are the bucket ladder and the suction hopper dredges. In America the dipper dredge, the hydraulic dredge and the seagoing suction dredge are the prevailing types, although various modifications of these and other types are extensively employed. The dipper dredge, however, can be called a distinctively American invention, or, rather, adaptation, as it is merely the logical development of the early makeshift apparatus formerly used by contractors who were accustomed to land excavations and were generally unfamiliar with marine requirements and construction. In recent years, however, the dipper dredges built in the United States are highly developed machines of large capacity, operated by powerful machinery and capable of meeting the severest conditions.

The bucket ladder type of dredge, which had its inception many years ago in England, has also been developed in large capacities, and has the advantage that it can be built in the form of a seagoing vessel of hopper construction, so that it can cut its own flotation and then carry the dredged material to a suitable place for its disposal. Although bucket ladder dredgers have been built to operate at depths of 50 feet below the level of the water, they are apparently not so well adapted to working in confined spaces, and it is impossible to handle large-sized boulders. The number of working parts in this type of dredge is large as compared with other types, and, for this reason, there is a tendency toward excessive cost of maintenance.

A type in which there is a less number of wearing parts, and which is specially suitable for handling softer material, is the seagoing suction hopper dredger, where the material to be dredged is drawn through a suction pipe by a centrifugal suction pump and discharged either into the dredger's own hoppers, or overboard into barges alongside, or through a long line of pipe to a place suitable for its disposal. With the ordinary hydraulic suction dredge, the percentage of solid material delivered to the hopper frequently amounts to only 15 to 20 percent of the discharge from the pump, although in certain specially constructed types of suction dredgers it is claimed that anywhere from 50 to 90 percent of solid material is delivered with the discharge.

Many improvements have been made in recent years in standardizing the design of hulls for dredgers, particularly in the seagoing suction type where the hull is similar to that of an ordinary steamship. In the dipper or inland hydraulic dredge, however, the design of the hull is usually open to improvement. It is necessarily of shallow draft, and the beam is limited, leaving the length as practically the only variable dimension. Provision must be made for supporting the heavy weights of machinery and for resisting the racking strains set up in the hull by the operation of the dredge. A box-like structure of bridge, or structural, construction is hardly suitable for such purposes and the design of such a hull should be carefully worked out by experienced naval architects, so that the necessary longitudinal and transverse strength will be provided for the excessive strains to which the hull is subjected.

The size to which various types of dredgers have been developed and their capacity can be seen from the descriptive articles published from time to time in this journal. One of the largest seagoing suction dredgers in existence is the *Leviathan*, built by Cammell, Laird & Company for the Mersey Dock & Harbor Board. This vessel is about 500 feet long, with a speed of 10 knots, and is capable of raising 10,000 tons of material from a depth of 70 feet below the waterline in fifty minutes. Another large seagoing suction dredge is the *New Orleans*, built by the Fore River Shipbuilding Corporation for service at the mouth of the Mississippi River. The *New Orleans* is over 300 feet long with a capacity of about 3,000 tons, and has handled material at the rate of about 1,500 cubic yards per hour. The seagoing suction dredges in New York harbor have a capacity for handling nearly 1,000 cubic yards per hour. A number of large suction hopper dredges have been sent out to India from English builders, one from Wm. Simons & Co., Ltd., for the Calcutta Port Commission, having a capacity of raising 5,000 tons of sand per hour. Two other reclamation dredgers, delivered by the same builders for the Bombay Trust, have handled as much as 2,700 cubic yards of material per hour, which is 35 percent in excess of the designed capacity.

The cost of dredging with a modern suction cutter dredge varies, of course, with the conditions under which the dredge is operated. In harbor work a hydraulic dredge of the most modern type has handled material at the rate of 574.9 cubic yards per hour at a cost of only 3.24 cents per cubic yard. On Lake Michigan, working in heavy clay in the open lake, subject to damage and detention of weather, a hydraulic dredge has excavated hard clay at a cost of less than 10 cents per yard, the cost including incidental expenses, repairs, supplies, insurance, etc., but not interest or depreciation.

The volume of tonnage represented by dredge construction each year is probably insignificant as compared with

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other classes of shipbuilding, but at the same time the importance of dredging operations to navigation is by no means insignificant. The sums of money spent each year in the improvement of harbors and rivers are continually increasing to meet the demands of the rapidly growing maritime commerce of the world and to make existing harbors of sufficient depth to accommodate the largest ocean liners. With the pressing need for deeper and more commodious harbors it is of the greatest importance that the actual harbor and waterway improvement operations should be carried out in the most economical manner, and for this reason dredge building has been developed into an important specialized branch of shipbuilding.

Electric Propulsion

That the field for the application of electricity afloat is by no means limited to auxiliary power purposes is clearly shown by recent practice in the United States navy and by experiments with a view of demonstrating the possibilities of extending the use of electricity to a number of novel applications in commercial work.

The most conspicuous project that is now being carried out is, of course, the installation of electric drive on the 30,000-ton battleship *California*. In this case the power for propelling the vessel is to be developed by two 18,000 horsepower, turbo-generating sets operating at 2,200 revolutions per minute. The power thus developed will be delivered to the propeller shafts by four 7,500 horsepower induction motors. At the full speed of 22 knots the power required is estimated at 36,000 horsepower, while at 14 knots only about 7,000 horsepower will be required. Due to the high efficiency of the electrical speed adjustment system employed it is claimed that the steam consumption per horsepower-hour will be approximately the same at both speeds. Seventy-five percent of the power generated theoretically by the ship's turbines will be delivered to the generators, and it is estimated that there will be a loss of only 8 percent in the electrical equipment. In addition to the electric power for propulsion, all of the engine room auxiliaries will be electrically driven by direct current taken from the small, non-condensing turbo-generators that supply excitation for the main generators. It is said that the use of electric drive on the *California* represents a saving of about $200,000 (£41,000) in the first cost of the propelling machinery, and that it offers superior economy in operation, besides reducing the weight of the propelling machinery and providing full power for reversing without the addition of astern turbines as is the case in direct turbine drive. Simplicity and reliability of operation have already been demonstrated with the smaller installation on the collier *Jupiter*, and there is good reason to believe that the larger installation on the *California* will demonstrate more conclusively the special advantages which this form of drive possesses for ships where the service is so varied and severe as on a battleship.

In addition to naval work, however, the possibilities of electric propulsion have attracted the attention of engineers engaged in commercial work and a number of novel proposals have been made as to its application in this field. In the paper by Mr. William T. Donnelly, which is concluded in this issue, is described a very complete installation of electric drive as made on a small boat for experimental purposes. This installation has many distinctive features which should be of great value in the scientific investigation of problems relating to ship propulsion. Some of the problems which it is proposed to attack include the efficiency of propellers under varying conditions of power and speed, the resistance of hulls while under the action of propellers, the influence of shallow water and confined waterways upon the resistance of hulls and many other problems of the greatest importance in naval architecture. With the instruments and apparatus provided on this boat it is believed that more exact and definite data can be obtained than is possible by the usual methods of model tank experiments. The flexibility of control of the electric power plant and the means which it affords for the measurement of power and other factors entering into such problems should make it possible to secure these data with an unusual degree of refinement and at a comparatively small expense.

Aside from the experimental work, however, it is intended to demonstrate with this boat the advantages of applying electric drive to towing. In handling a tow of barges with an electric towboat it is proposed to generate the power on the towboat in the form of electricity, and then to transmit the power to the individual barges in the tow by means of a flexible conductor, each barge to be provided with its own propeller and motor with the control on either the barge itself or on the towboat. This method of towing, the author of the paper believes, will offer exceptional advantages for handling a tow in confined waters or in maneuvering about a harbor or in a canal and for increased economy in propulsion. It is also pointed out that with an electric power plant available on the towboat, power could be furnished not only for propelling the barges but also for operating refrigerating machinery for a cold storage system on the barges, so that cargoes of perishable goods could be transported economically by water.

Taking a step further, the author suggests the possibility of adapting an electric power boat to the propulsion of regular passenger boats with the advantage that by isolating the power generating plant in a separate hull the passenger boat could be made practically safe against sinking and against fire as well as eliminating the annoyances arising from the proximity of the power-generating plant on the boat itself. While such a scheme might not prove practicable for a large ocean-going liner, there is a class of steamers operating on short routes on sheltered waters where such an arrangement might prove feasible, with the special advantage that the power boat could be operated continuously. Under such conditions the power boat would become in reality a floating electric power station and the possibilities for the sale of its power, both ashore and afloat, would become almost unlimited.

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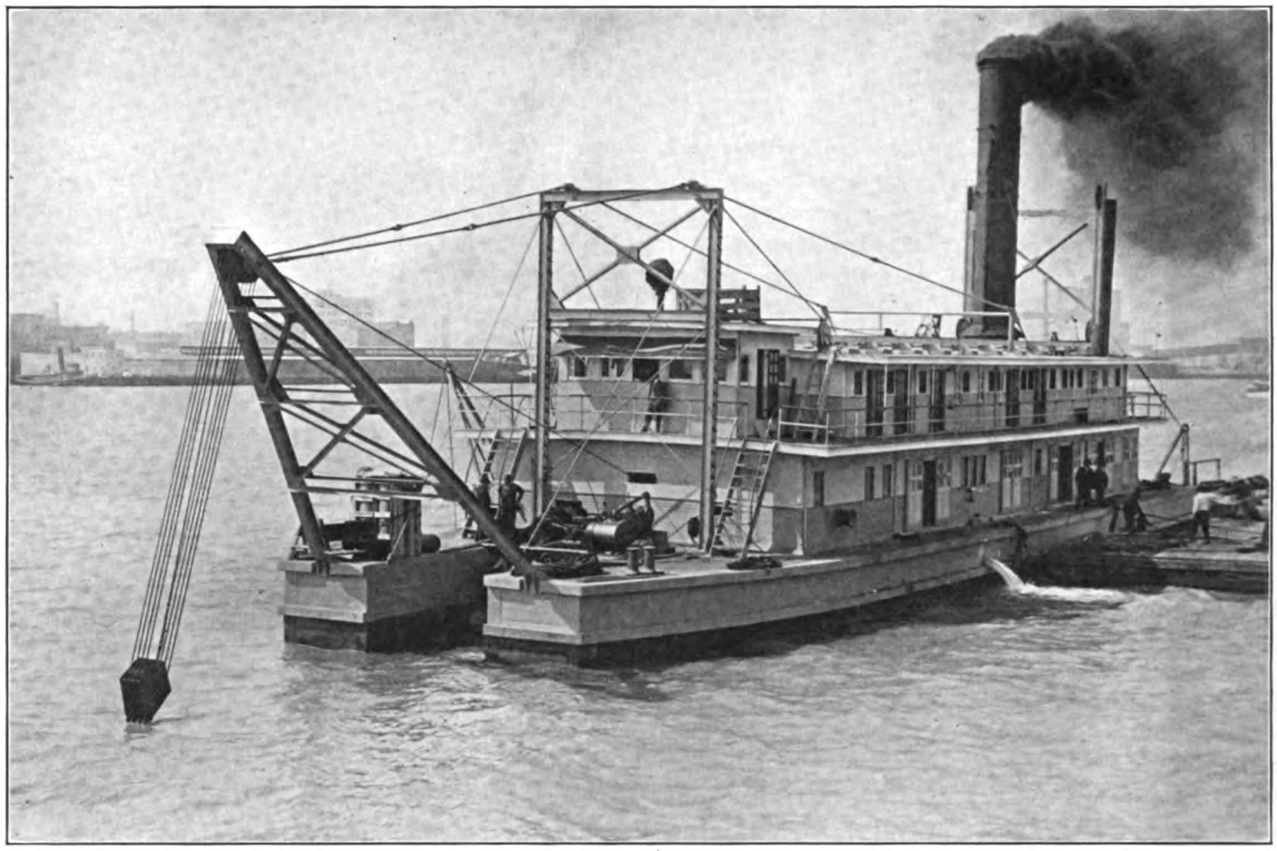

Fig. 1.—Government Dredge *San Jacinto* Undergoing Test

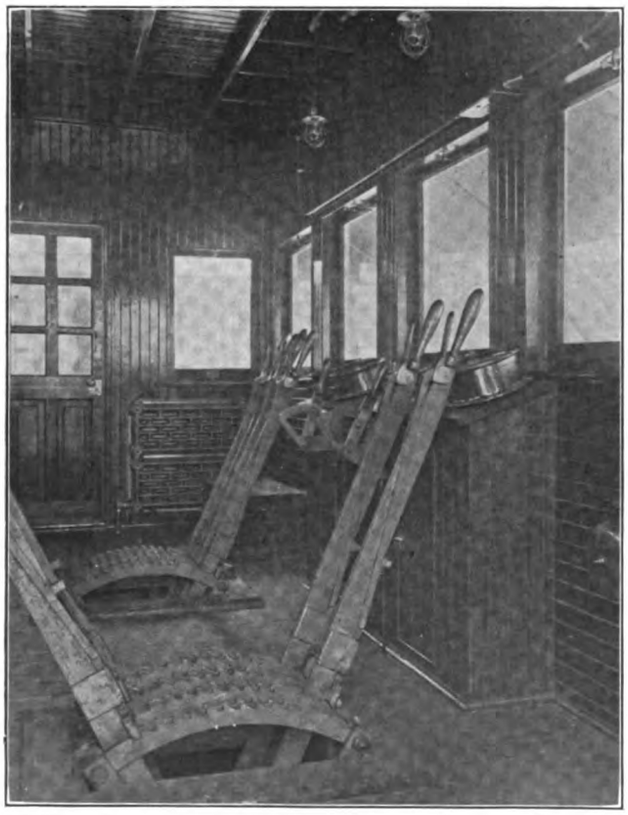

Fig. 2.—Controls in Lever Room

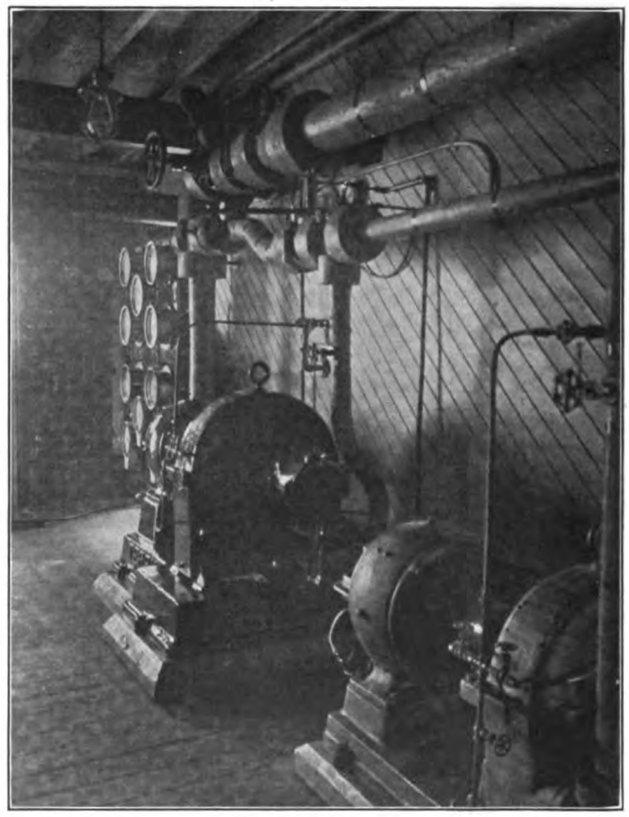

Fig. 3.—Terry Turbo Generating Sets

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The Latest United States Dredges

Description of Two Suction Cutter Type Dredges Built for Improving the Houston Ship Canal

BY P. M. BRUNER

In Galveston, Tex., two of the latest type of cutter pipe line dredges are rapidly being completed by the Bowers Southern Dredging Company for the United States Government. These dredges, the *Sam Houston* and *San Jacinto,* will cost $200,000 (£41,000) apiece, one-half this sum being borne by the government, and the other half by the city of Houston. They will be used in the Houston ship canal, which connects Houston with the Gulf of Mexico, and for which two and a quarter million dollars (£513,000) was appropriated for improvements.

The hull was built in Orange, Tex., and then towed to Galveston to have the machinery installed and be completed. It is 148 feet in length with a 38-foot beam and a depth of 12 feet. The bottom planking is 4 inches by 12 inches, the sides 5 inches by 10 inches and the lumber Georgia long-leaf yellow pine.

The pumping engine is a vertical triple expansion condensing engine, the bore of the cylinders being 14, 22½ and 40 inches respectively and the stroke 20 inches. It was designed for a normal running speed of 180 revolutions per minute, but will run safely at 200 revolutions per minute and develops probably about 800 horsepower. This engine is direct-connected to the main dredging pump, which is of the single suction volute type with 21-inch suction, 20-inch discharge and 96-inch diameter runner. The engines and main pump are of the Bowers Southern Dredging Co. type, built by the Morris Machine Works.

This machinery is in a well in the hold about 20 feet wide and 30 feet long. The suction pipe runs out from the pump through the hull and along the cutter ladder to the cutter, the blades of which are so formed as to induce the material to enter the suction. The discharge pipe runs back through the hold and emerges at the left side of the stern above the waterline.

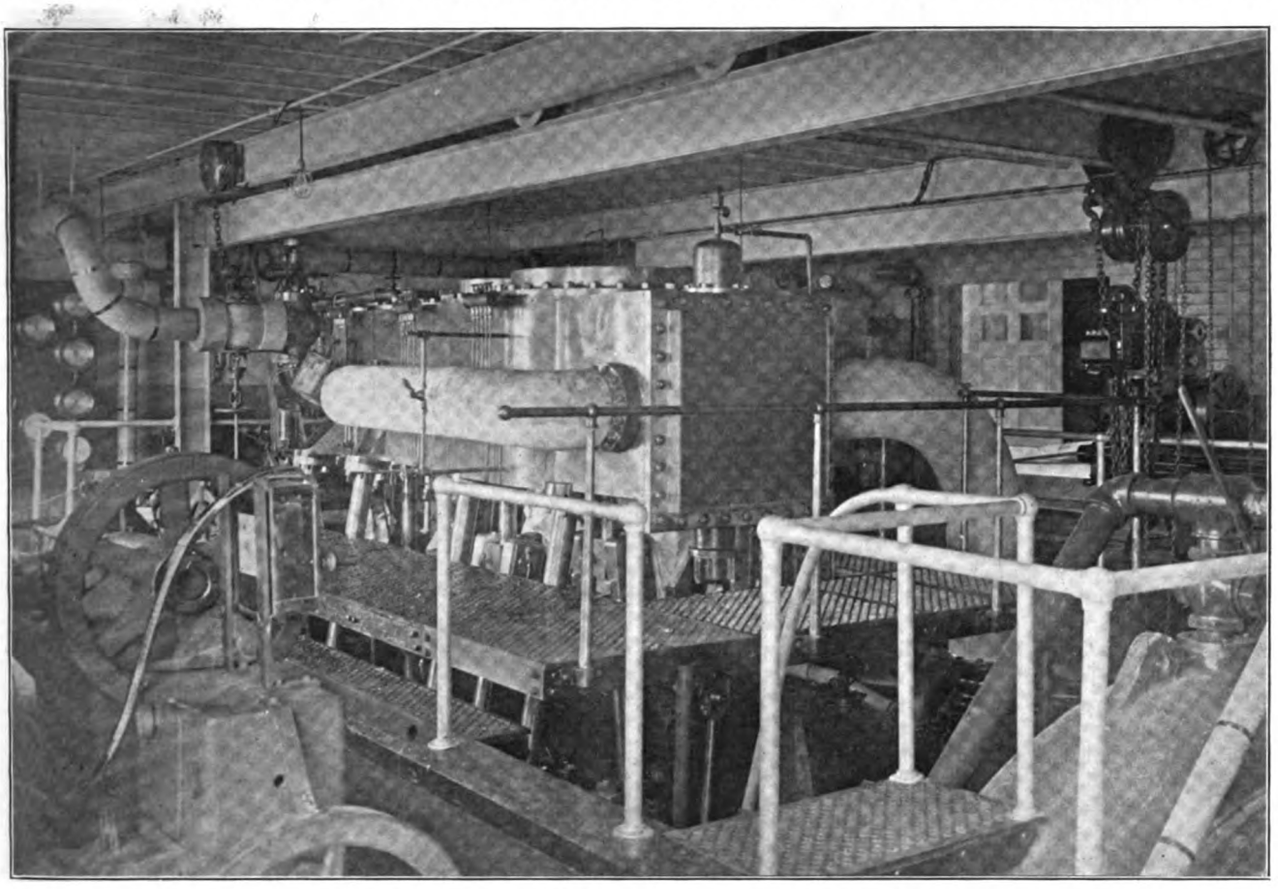

Fig. 4.—View of the Engine Room of the *San Jacinto,* showing Main Dredging Engine and Pump

The cutter ladder is the Bowers heavy I-beam construction and carries the suction pipe, cutter shaft and cutter. It is raised and lowered by means of the A-frame shown in the illustration. The cutter is of the Bowers extra heavy type and is driven by a double horizontal non-reversing 12-inch by 14-inch engine at a speed of thirteen revolutions per minute.

The spud frames are of the standard heavy construction and carry the spuds. These are long, heavy timbers with heavy pointed iron shoes and are let drop, thus anchoring the stern but allowing the dredge to turn on the spud acting as a pivot.

For swinging the dredge two 3,000-pound anchors are dropped some distance to the right and left forward of

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Fig. 5.—Discharge from 10-inch Nozzle Representing 1,000 Feet of Pipe Line

Fig. 6.—Type of Metal Pontoons Used for Carrying the Pipe Line. Each Dredge Carries Forty of These Pontoons

the bow. These swinging wires lead to the forward end of the engine room, where the engines for swinging the dredge are located. The swing or width of channel possible to cut is 200 feet, and the dredge is capable of cutting this to a depth of 45 feet. The hoisting equipment was built by the Bowers Southern Dredging Company.

Each dredge carries as part of its equipment 40 cylindrical metal pontoons, 5,000 feet of pontoon line and 1,000 feet of shore pipe.

The boilers, of which each dredge has two, are of the Babcock & Wilcox type and have a working pressure of 225 pounds and are fired with oil burners of the Peabody type. A fuel tank installed forward of the fire room is 8 feet in diameter by 20 feet long.

In the hold forward of the engine a complete double-effect evaporating plant, supplied by the Griscom-Russell Company, is installed for producing make-up feed water for the dredge and for drinking, culinary and fresh water purposes. The plant has a capacity of 9,000 gallons distilled water per 24 hours, 1,000 of which is distilled, filtered and set aside for drinking purposes. Two fresh water tanks 4 feet in diameter by 15 feet long are installed in the wing compartments in way of the boiler room.

There are two turbo-generators of the Fort Wayne type, of 125 volts, direct-connected to Terry turbines; one of 15 kilowatts and the other of 10 kilowatts capacity. These will serve all the signal, search, arc, incandescent lights, fans and motors of General Electric make.

A complete blacksmith and machine shop is part of the equipment and is located on the main deck. The machine tools are all individual motor drive, the more important being a 20-inch lathe, 36-inch drill press, 24-inch shaper, bolt cutter, pipe machines for cutting and threading pipe up to 6 inches in diameter and a complete outfit of grinding tools supplied by the Niles-Bement-Pond Company.

The lever room forward on the upper deck has glass windows and doors to give a view on all sides and is so arranged that the spuds in the rear can also be seen. All the dredging machinery is controlled from this room. All handles, levers and valves necessary for this purpose are led from the several clutches, brakes and engines through the upper deck and to the lever room, where they are so arranged for handling that the lever man may at all times have a full view of the various operations. Each lever and clutch handle is plainly marked with the name of the part it controls and the room is fitted with gongs, speaking tubes and gages, which are in full view of the operator. A searchlight mounted on top of this room and operated from it is of 35 amperes capacity and has an 18-inch reflector.

Every convenience for the crew is provided. The whole boat is electrically lighted and large fans ventilate the upper deck, which is given over almost completely to the crew. A one-ton capacity Brunswick direct expansion ammonia type ice machine furnishes plenty of ice and is arranged for cooling a cold storage room on the upper deck. In cool weather the rooms are heated with steam wall radiators. The rooms of the captain and chief engineer have all these conveniences, together with a wash-

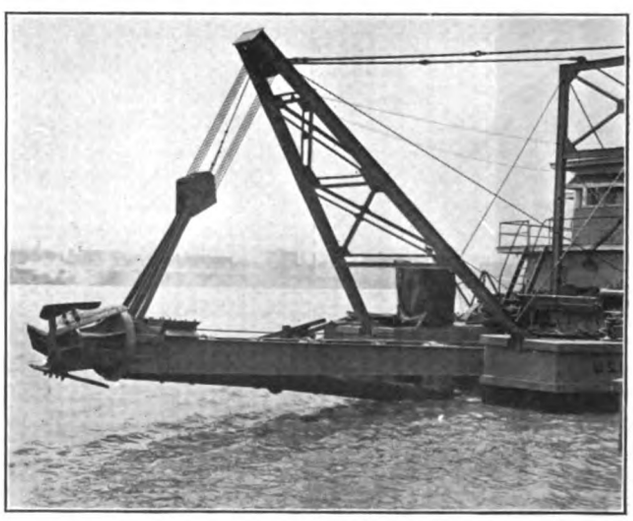

Fig. 7.—Cutter and Suction Pipe

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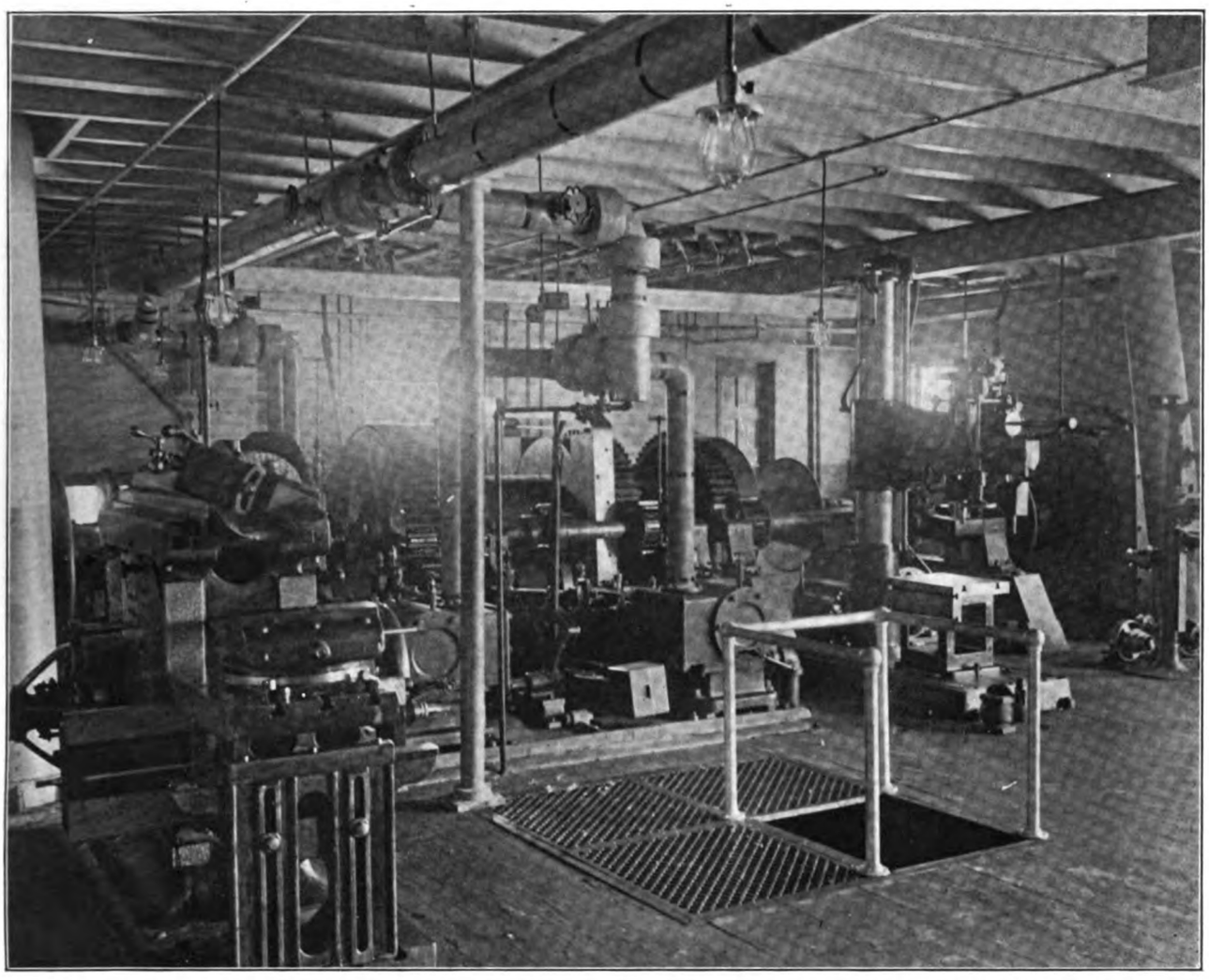

Fig. 8.—Forward Part of Engine Room, Showing Some of the Machine Tools and also the Engines for Swinging the Dredge and Raising and Lowering the Cutter

stand, and a private bath is provided for the chief officers. The crew have double iron bunks and their bath rooms, one on the upper and one the lower deck, are fitted out with showers. The office is equipped with oak roll-top desk, typewriter, letter copying stand, letter press, revolving chair and berth.

The *San Jacinto* has gone into commission and is in charge of Captain A. F. Symms, who has been in the government service sixteen years, ten years of which was spent in the Galveston district. He was then transferred to Panama and served as master and supervisor of the dredges on the Atlantic side. The chief engineer of the dredge is Mr. R. P. Prendergast, who for sixteen years has been in the service of the government and of the North American Dredging Company. Mr. Prendergast was chief engineer of most of the large government dredges at Galveston and was then transferred to the engineering department at Seattle, Wash., finally being transferred back to Galveston. This work was under the supervision of Captain George M. Prendergast, who has had charge of the Galveston district for twenty years.

Dredge Tender for U. S. Army Engineers

Last October the War Department of the United States Government requested naval architects to submit sketches for a proposed tender for the use of the United States army engineers' office at Galveston, Tex. A number were submitted, but the design by William J. Deed, Jr., of Boston, was selected. The boat is now under construction by the United States army engineers at Galveston. She will be called the *Victoria* and will be in use by the time operations are begun on the channels of the Texas coast.

The boat will be 34 feet length overall, 33 feet 3 inches length on the waterline, 8 feet 8 inches breadth over planking, and 2 feet 11 inches draft. The lines have been drawn with a view to producing a boat that will tow without squatting and also drive easily when running without a load. She is provided with heavy towing bitts for handling barges and has bitts well amidships for handling the barges in the narrow channels and bayous. She also has towboat fenders and bumpers and very heavy guards. A derrick mast operated by hand is provided, as spare parts and supplies for the dredges will be carried. A hunting cabin provides quarters with 6 feet 1 inch head room, cooking, sleeping and toilet accommodations.

The motor will be a four-cylinder, four-cycle, 5¾-inch by 7¼-inch Twentieth Century, and will drive the boat better than 10 miles an hour. Controls for the motor are brought to the steering wheel so that the boat will be a one-man craft. She will have Sands plumbing, and fuel tanks of 132 gallons capacity of seamless steel made by Janney, Steinmetz & Co.

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Reconstruction of U. S. Dredge Barnard

BY J. R. PEYTON

The twin screw dredge *Barnard* was built by the New York Shipbuilding Company in 1904, to assist in opening the South West Pass of the Mississippi River. The general dimensions are: Length, 213 feet; beam, 38 feet; depth, 14 feet 6 inches; draft, 8 feet. The propelling engine room is at the stern, with the pumping engine room forward, the boiler room being between them.

Originally there was a well on the centerline of the hull 7 feet wide, beginning 28 feet from the bow and extending aft for a distance of 60 feet. A suction pipe with drag head rested on trunnions at the forward end of the well. The pumping installation consisted of a 36-inch double suction centrifugal pump directly connected to a triple expansion engine. The discharge pipe leads to either side and to the stern.

The method of dredging was to cruise up and down the cut, towing the pontoon discharge pipe line at the side, it being held abreast of the dredge by either a self-propelling scow or by a baffle plate at the discharge end. This process was found to be impractical and the material was discharged directly overboard at the stern, depending on the current to carry it over the bar into deep water.

After working in several localities, it was decided to convert the *Barnard* into a cutter dredge of the spud pipeline type, it being considered impractical to combine successfully a bar and harbor dredge. The work was done at the Navy Yard, Charleston, S. C. The old pumping installation was replaced by a 22-inch single suction steel pump of the volute type. It is directly connected to a triple expansion engine having cylinders 17, 22½ and 40 inches in diameter with a common stroke of 20 inches and placed athwartship.

The center well was extended to the bow and the after end closed for a distance of 29 feet. The well is decked over at the bow. A cutter ladder 60 feet long and weighing about 65 tons was placed on trunnions at the after end of the new well. A 10-inch by 12-inch double horizontal non-reversible cutter engine was placed fore and aft on the ladder over the trunnions. A minimum of vibration is thus secured. The 7½-inch cutter shaft is driven through cast steel cut gearing and is provided with a heavy thrust bearing. The cutter is cast steel and of the spiral type as seen in Fig. 2. A ball joint makes the flexible connection in the suction pipe at the hull. There is no stone box. The dredge can dig to a depth of 35 feet and make a cut 300 feet wide on one advance. The A-frame back stays were secured to the structural runway over the old well formerly used to handle the suction head.

The spuds are Oregon fir, 33 inches in diameter and 60 feet long, and are reinforced with strips of Swedish iron. One spud was placed inboard and the other outboard of the propeller shafts. The spud gallows frame extends 36 feet above the deck. The winding machinery is operated by a double horizontal reversible 8½-inch by 12-inch engine and is located on the main deck forward of the pumping engine room.

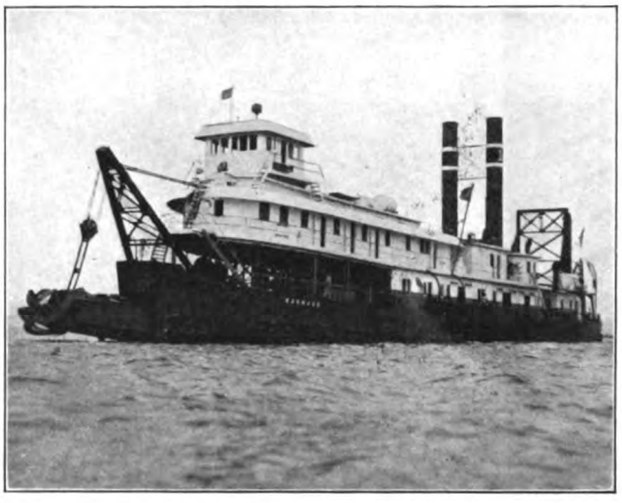

Fig. 2.—The Reconstructed Dredge *Barnard*

The combined pilot house and lever room was moved 46 feet forward. The distance being considered too great to operate the ordinary hand levers, a system of hydraulic control to the winding machinery and the cutter engine was installed. A pressure of about 60 pounds per square inch is maintained by a duplex pump with an automatic pressure regulator. The system is piped up to a fresh water tank and includes a spare pump. The hydraulic cylinders are proportioned to produce about 750 pounds piston thrust to operate the frictions and brakes. This installation has proved satisfactory in service.

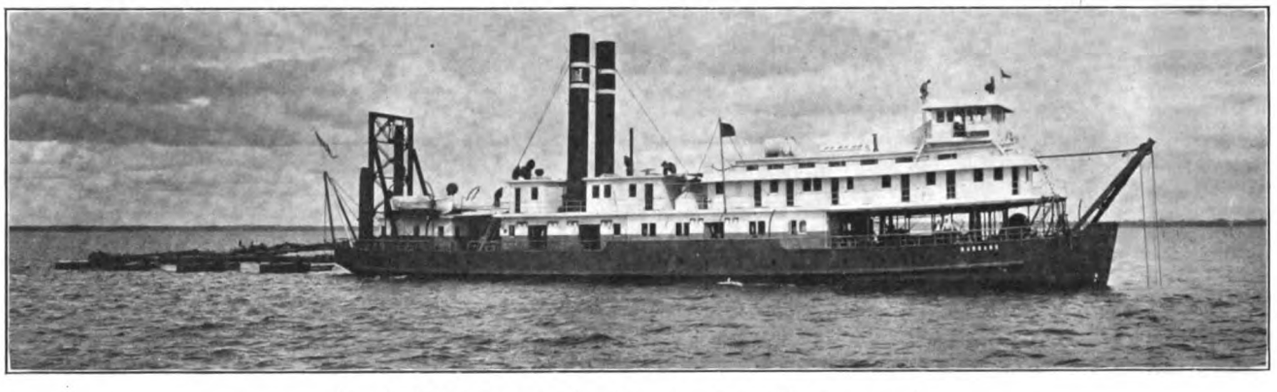

Fig. 1.—Twin Screw Dredge *Barnard* as Originally Constructed

An extensive series of nozzle tests was conducted by utilizing a nozzle equivalent to 5,000 feet of 22-inch discharge pipe. The discharge pressure was 43 pounds per square inch at 165 revolutions per minute of the pumping engine. A ship's taffrail log was used in the hull discharge pipe to determine the velocity of the discharge.

The open well does not affect the steering qualities of the dredge and she can maintain a speed at sea of about 9 knots. The *Barnard* is now engaged on the improve-

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ment of Tampa harbor, Florida, and her performance there has shown the superiority of the present method of operation.

Hydraulic Dredge for Cuyahoga River Improvement

BY H. FIES *

At the new plant of the Otis Steel Company, in Brooklyn, O., a suburb of Cleveland, an interesting engineering project is now under way, involving the reclamation of some very valuable land and the straightening of the Cuyahoga River. At this point, and along the foot of a range of hills, the river makes a semi-circular bend about a mile in diameter and traversing a tract of ground containing about 350 acres, which heretofore has lain idle. It was decided to cut a new channel for the river directly across

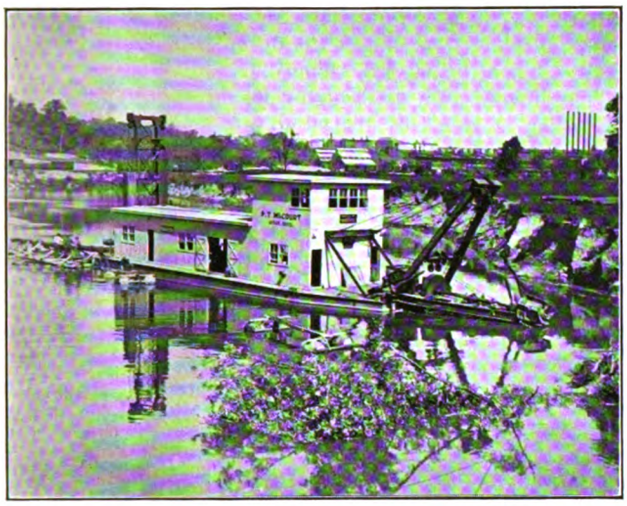

Fig. 1.—Electrically Driven Hydraulic Dredge for Cuyahoga River Improvement

the base of this curve and to use the spoil from the cut to fill in the ground for the new steel works. The buildings for the plant had been previously built on concrete piers to permit the elevation of the land to be raised from 4 to 15 feet above the old level. Directly in the path of the new channel was a hill about 200 feet high, through which it was necessary to cut and which it was decided to cut entirely down in order to obtain sufficient material for completing the reclamation work and for filling in the old river channel.

The contract for the excavating and filling was let to P. T. McCourt, contractor, of Akron, O., who decided that

* Mechanical Engineer, the Marion Steam Shovel Company, Marion, O.

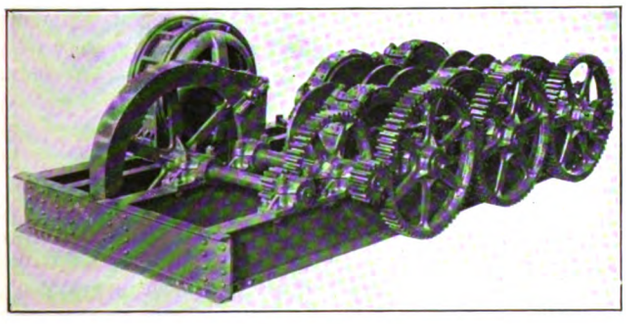

Fig. 2.—Five-Drum Winch

the most feasible method of operation would be to cut down the hill with steam shovels and to excavate the new channel with a hydraulic dredge, the latter at the same time to fill in the low ground through a long pipe line. Work was accordingly started on the hill last spring with two

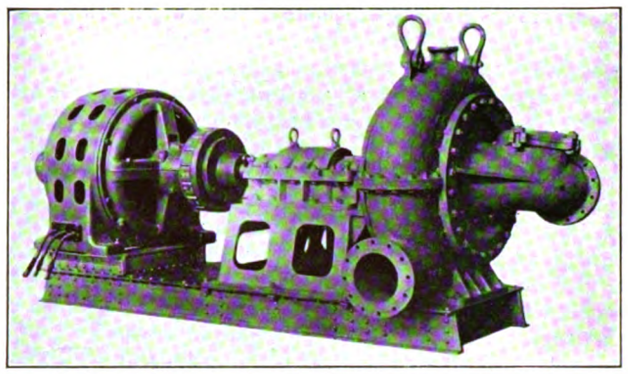

Fig. 3.—Main Dredging Pump

Marion Model 61 steam shovels, using dump cars to deliver the spoil to the various points around the hill which required filling.

The hydraulic dredge for this work is of special design (Fig. 1) and was built complete by the Marion Steam Shovel Company, Marion, O. The hull is 80 feet long, 25 feet wide and 5 feet deep, built of steel throughout. The frames of the hull run atwartship and consist of channels, top and bottom, with vertical angles connected to them by gusset plates. Two fore and aft trusses provide the necessary longitudinal stiffness, these trusses being connected directly to both the top and bottom members of the cross frames. All plating for the bottom, sides and deck is laid fore and aft, the after part of the deck between the trusses being cut out to form a cockpit for the dredging pump. The bow and stern gantries are also of steel,

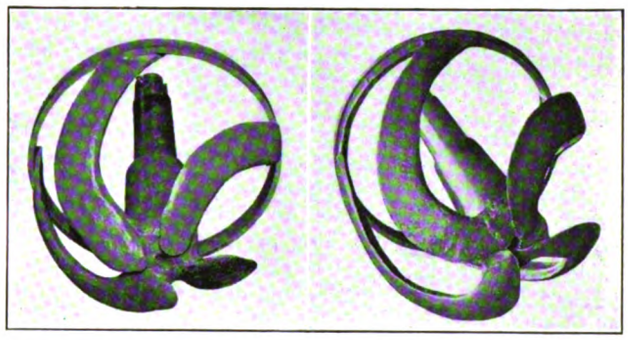

Fig. 4 Fig. 5

the stern gantry being directly connected to the stern of the dredge and the after end of the main trusses, while the bow gantry is pin-connected to supports on the deck and held in place by steel cables fastened to the forward end of the main trusses.

The pilot house is built on top of the fore and aft trusses, and so placed that the operator can have a clear view of the work at all times. The pilot house contains the winch levers, gages, switchboard and all controlling apparatus, so that every operation of the dredge is controlled by one man. The switchboard consists of three slate panels mounted on a pipe framework. On these panels are mounted a voltmeter and an ammeter, together with the

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circuit breakers and fuses protecting the various power and lighting circuits. The lighting system is supplied with current taken from the secondary of a 5-kva transformer. A ten-inch searchlight is installed so it can be used either on the bank or pontoon line. All machinery is driven by 3-phase, 60-cycle, 2,200-volt, General Electric Company motors, the variable speed motors being of slip-ring type, equipped with fourteen point reversing controllers. The current is brought on board by a flexible submarine cable connected to transmission lines running parallel to the cut.

The main dredging pump has 16-inch suction and discharge openings and, by means of a flexible insulating coupling, is direct connected to a 300-horsepower motor mounted on the same bed plate (Fig. 3). The pump is designed to deliver 225 cubic yards of solid material per hour through 1,000 feet of discharge pipe and to an elevation of 12 feet above the waterline when running at 345 revolutions per minute. Owing to the great variation in the length of the discharge line required at various times, the motor was provided with controlling apparatus for running continuously with 25 percent speed reduction.

In order to knock down part of the hill and sluice material into the cut immediately ahead, a 2-inch hydraulic giant is mounted on the bow of the dredge in such a way that it can be swung independently and have a large radius of action. Water for the giant is provided by a 6-inch, 3-stage, Worthington turbine pump, delivering 1,300 gallons per minute at a head of 360 feet, and which is direct connected to a 200-horsepower motor operating at 1,140 revolutions per minute. A 3-inch Worthington volute pump, direct-connected to a 15-horsepower motor, operating at 1,140 revolutions per minute, is provided for fire protection, hosing off the deck, priming the main pump and for the various water-sealed stuffing boxes on the pumps and suction pipe.

A 5-drum winch (Fig. 2) driven by a 20-horsepower motor is used for handling the swinging lines, raising the cutter ladder and operating the spuds. The motor is provided with controlling apparatus for any variation in speed from full speed down to half speed and is also fitted with solenoid brake. The motor is direct-geared through intermediate shafts to the drum shafts. Each drum is provided with internal expanding friction and outside brake band, each one of which is separately controlled from the pilot house.

The cutter drive and suction pipe are mounted on a structural steel ladder, suspended at the bow of the dredge on steel trunnions. Through one of these the suction pipe passes and the joint is sealed to exclude air by means of water forced into the packing by the 3-inch pump. The ladder is raised and lowered by cables running over sheaves in the top of the bow gantry and down to a drum on the winch machinery. The cutter is driven through reduction gearing by a 75-horsepower motor, running normally at 575 revolutions per minute, but fitted with controlling apparatus for operating continuously at 50 percent speed reduction. The cutter originally furnished was of the heavy type, having removable manganese blades, but after the dredge had been put into operation the sub-soil was found to consist of sticky blue clay of the sort commonly called "Gumbo," and the cutter was found to be unsatisfactory, owing to the material clogging it up and refusing to enter the suction pipe. A cutter was then installed having four knife-like blades, curved in the shape of an auger (Fig. 4), which was found to do excellent work. This cutter was later replaced with one of the same pattern, but of greater length (Fig. 5), as it was found difficult to properly gage the forward steps of the dredge with any great accuracy, the tendency being to overstep and leave uncut material behind the cutter. A great deal of trouble and delay has been caused by logs imbedded in the soil and which must be pulled out before the dredge can proceed. Some of these logs are 24 inches in diameter and 35 feet long, and as many as six have been found in the cut at one time.

The new channel will be 8 feet deep and 150 feet wide, and later it may be deepened to permit navigation. When this is done the Otis Steel Company contemplates the building of docks on the west bank of the river.

Types of Dredgers Built in the United Kingdom

The best known types of marine dredgers built in the United Kingdom are bucket ladder dregders ("hopper" and "barge-loading"), cutter suction hopper and reclamation dredgers, and trailing suction hopper dredgers. It should be added, however, and perhaps emphasized, that the types named vary in essential details and features with the varying conditions prevailing in the different ports, harbors and rivers in which they are employed.

The introduction of dredging machines into the United Kingdom is generally placed in the reign of Charles I, when some Dutch engineers came over to carry out improvements connected with the great Bedford level. About the middle of the second half of the eighteenth century considerable improvements were effected in dredging appliances, particularly in connection with dredging operations on the Clyde, and further improvements were made in 1805 in connection with the deepening of the Thames.

The application of steam propelling power to dredging vessels was made in 1861 in the construction by William Simons & Co., Ltd., Renfrew, of two hopper steamers to the order of the Trustees of the Clyde Navigation. These were the first self-propelling vessels employed for transporting and depositing dredgings in deep water. Experience has amply demonstrated on the Clyde, Thames and Mersey, and on many other rivers and canals, that the substitution of "steam hoppers" for tugs, with their string of punts or scows, was a step in the right direction.

A later development was brought about by combining in one vessel the distinctive features of the bucket ladder dredger and of the steam hopper barge, which resulted in building the type of dredger now known as the "hopper" dredger. The first vessel of this type was the *Canada*, constructed by Messrs. Simons & Co. in 1872 to the order of the Dominion Government. The most powerful dredger of this type yet constructed is the *Corozal*, described in previous issues of this journal, which was built for service at the Panama Canal. A record made by this dredger was the excavation of 13,700 cubic yards of material, 90 percent of which was rock, in 19 hours 50 minutes.

In recent years remarkable developments have taken place in the application of suction dredging by the introduction of mechanical devices working in front of the suction nozzle. This type of dredger is now able to handle many different kinds of material, ranging up to the stiffest class of blue clay, chalk and soft rock, whereas formerly they could be used profitable only in sand or sand and silt. The cutter suction type of dredger has an advantage over the bucket ladder dredger in that there are fewer parts subject to wear.

A still further development of the suction dredger is known as the trailing suction dredger, in which a trailing suction pipe, having an elongated suction opening, is employed. This type of dredger works without moorings and has proved very efficient and economical where material of a soft, silty, clayey nature is met.

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Four-Yard Government Dipper Dredges

Description of Government Dredges Davenport, Keokuk and St. Paul, Built for Improving the Upper Mississippi River

During the season of 1914 the United States Government completed the three four-yard dipper dredges *Davenport, Keokuk* and *St. Paul*. These dredges were designed and built at Rock Island, Ill., for use in improving the upper Mississippi River between St. Louis and St. Paul. One dredge is now in service below the new government lock at Keokuk, Iowa, another on the Rock Island Rapids just above Rock Island, Ill., and the third in the vicinity of Minneapolis. The three dredges are similar in all respects.

The dredges have steel hulls, with single-deck wooden cabins built on a skeleton framework of steel cabin and roof trusses. All the machinery, with the exception of the capstan engines, is located on the main deck, making it convenient to operate, maintain and repair same and avoiding the necessity of large openings in the deck with consequent loss of strength. The main hoisting engines are located on the centerline of the hull about amidships, the large gears projecting slightly through an opening in the deck. The forward spud engines are placed on each side of the main engines and the swinging engine forward and starboard of the main engines. The main boiler is located just aft of the main engines. All machinery is controlled from the operator's stand.

Hull Construction

The hull is constructed of open hearth steel, 110 feet in length, 40 feet beam and 6 feet depth, with a 6-inch crown to the deck. The forward end of the hull is square except for a 12-inch cut-off at the bottom on the angle taken by the dipper handle when in its lowest position, which thus presents a flat surface instead of a sharp corner for the dipper to strike against and permits digging closer to the hull than would otherwise be possible. The after rake is brought up on an easy curve in order to present the least possible resistance when the dredge is being towed stern foremost.

In order to take care of the strains to which it is subjected when spudded up and digging rock, the hull was made exceptionally strong and rigid, and the maximum fiber stress was kept at a very low figure. The hull is framed fore and aft in order to obtain maximum strength with minimum weight. The deck and floor beams are 6-inch ship channels extending the entire length of the hull. Two fore and aft watertight bulkheads extend the length of the hull, at a distance of 9 feet 9 inches from the gunwale, and in addition there are two fore and aft trusses, spaced 2 feet 6 inches on each side of the centerline, to provide additional stiffness and act as supports for the boiler and machinery.

Two transverse watertight bulkheads divide the hull into nine watertight compartments. The transverse bulkheads are made watertight, where pierced by floor and deck beams, by the use of cast-steel staples calked watertight. Transverse trusses are worked every 11 feet throughout the length of the hull. The plating is ⅜ inch thick for two-thirds of the length amidships and ¼ inch thick at the two ends. A suction tank, connected to the river by a 6-inch valve, is provided in the hull as a source of supply for the pumps and injectors. Doubling plates are provided under all machinery, boilers, sheave brackets, cavels, chocks, etc., and in way of all manholes and openings in the deck.

Spuds and Spud Wells

The forward spud wells, located outside of the gunwale 5 feet from the bow, are secured to the hull by a system of plate and angle brackets and are built up of 7-16-inch plates extending 12 feet above the deck. The outboard side of the well is open to permit the removal of the spud and the spud is held in place by cast steel gates. The well is stiffened by fore and aft, as well as transverse, diagonal channel struts. The spuds are of Oregon fir, 30 inches by 30 inches by 38 feet long, and are fitted with 30-inch steel bronze bushed sheaves mounted on top and in a mortised slot just above the shoe for the spudding up and lifting cables.

The after spud well is formed by a slot in the rake along the centerline of the hull to accommodate a 20-inch by 20-inch walking spud. The spud shoes are rectangular steel castings with detachable conical crucible steel points which are interchangeable. The points are considerably smaller than the bottom of the shoe, leaving sufficient bearing surface to prevent the spud from unnecessary sinking in soft material. Broken or dulled points are very easily renewed.

The dredging machinery proper was furnished under contract by the Marion-Osgood Company, Marion, Ohio. The machinery was designed for digging to a maximum depth of 18 feet and a minimum depth of 6 feet, and for adequate power for handling a four-yard dipper in ordinary material. An extra heavy and wide two-yard dipper with teeth was furnished for digging rock with a low face. The parts were designed, with an ample margin of safety, so as to stall the engine with 125 pounds boiler pressure.

Main Engines

The main engine is double-cylinder, 12 inches bore by 16 inches stroke, non-reversible, with hoisting drum compound geared ahead of the engines and backing drum forward of hoisting drum. It is mounted on a heavy structural frame of 20-inch I-beams and plates giving straight leads above deck for the hoisting rope and backing chain. The hoisting drum is of steel, 45 inches in diameter and grooved. The backing drum is of steel, 27 inches in diameter and smooth. An extra gear and pinion is provided for changing the ratio of gearing for double hitch between point of boom and dipper. All gears are of cast steel with cut teeth. Frictions are of the outside band type set up by steam rams bolted to the gears. The lowering band is operated by foot through a powerful toggle connection. The main throttle is of the balanced piston type. All engine cylinders are fitted with automatic cylinder cocks.

The swinging engines are 8 inches bore by 8 inches stroke, double cylinder, reversible, with central valve, compound geared, and mounted on a framework of 12-inch I-beams. The gears are of cast steel with cut teeth and the drum is 26 inches in diameter and grooved for a 1⅜-inch swinging rope.

Spud Engines

The forward spud engines are exact duplicates of the swinging engine; but in addition have a brake wheel mounted upon the intermediate shaft for holding the spud in any position. The wheel is 42 inches in diameter, fitted with a heavy band lined with maple blocks and locked by

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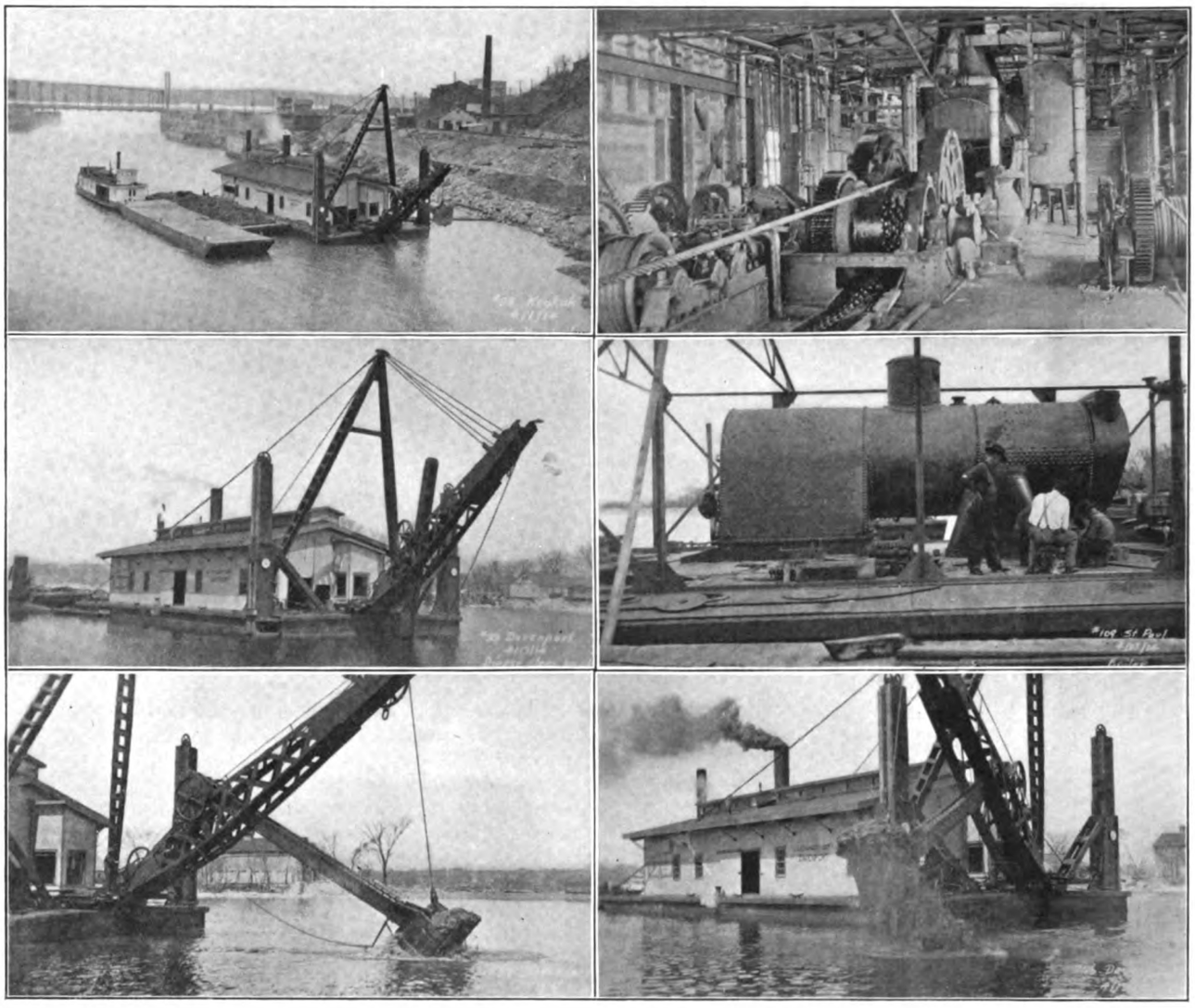

Fig. 1.—Dredge *Keokuk* in Operation at Keokuk
Fig. 2.—Interior of Dredge *Davenport*
Fig. 3.—Dipper Lowered for Digging
Fig. 4.—Boiler for Dredge *St. Paul*
Fig. 5.—Picking Up the Load
Fig. 6.—Dumping the Load

means of powerful toggle levers operated by hand from the operator's house. The spudding up and lifting cables are operated through suitable guide sheaves and the engines have sufficient power to raise the bow of the dredge high enough to insure absolute stability for digging.

The after spud engines are 6 inches bore by 6-inch stroke, double cylinder, reversible by a central valve, and are of similar construction to the swinging engines. The after spud drum is of cast iron, 17 inches in diameter, keyed on a 4-inch shaft which is mounted, together with the intermediate shaft, directly upon the after spud well casing. The intermediate shaft is fitted with a jaw clutch for disengaging the engine and with a brake wheel for holding the spud.

The swinging circle is mounted on a heavy steel base casting, bolted directly to the deck and having a lip projecting over the forward end of the hull. This lip is bolted to the hull and carries a backing chain guide sheave. The backing chain leads above deck through a cored hole in the base casting. The journal is 3 feet 5 inches in diameter and 12 inches high. The center casting is also of steel and to it is riveted the swinging circle, 15 feet in diameter, which is built up of 6-inch by 4-inch and 5-inch by 3½-inch angles and plates with a rim of 7-inch ship channel. Eye-bolts for attaching the ends of the swinging rope are arranged for taking up the stretch of the ropes and are provided with springs for absorbing shocks. Between the base and the center are a cast iron bushing and a cast iron plate to take up wear. On the center are mounted two sheaves grooved for 1¾-inch rope, 4 feet pitch diameter; between which the hoisting rope passes. The sheaves are of cast steel bronze bushed.

Boom

The boom is about 45 feet long from center of hinge pins to center of point sheaves. The main corner angles are extended beyond these sheaves with a shaft from which are hung two double tackle-blocks for lifting large rocks from the dipper. The boom is constructed of steel angles and plates, strongly braced. The corner angles are 8 inches by 8 inches, outside reinforcing angles 4 inches by 4 inches, and girder angles for dipper handle 6 inches by 4 inches. The point and heel sheaves are 64-inch pitch diameter, grooved for 1¾-inch rope and bronze bushed. Four 1½-inch wire rope boom guys extend from the point of the boom to the A-frame head.

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The A-frame stands about 48 feet high above deck and is built up of four 15-inch channels and plates, braced and riveted. All castings are of steel, including bases, which are 48 inches by 24 inches. The top casting has a journal 13½ inches in diameter with a ¾-inch phosphor-bronze bushing, on which the revolving collar of steel works. A-frame back guys, 2¼-inch cast steel, 6 x 19 wire rope, extend from the A-frame to steel plate brackets at the extreme after corners of the hull.

DIPPERS

The rock dipper is 2 cubic yards capacity, struck measurement, with mangenese steel front and lip, cast steel back, and four extra heavy forged teeth. In order to give the dipper unusual width for its size, the front and back castings of a 3-yard dipper were used, and the distance from front to back reduced in proportion. The front and lip are separate castings, so that the lip may be removed without the front. The hoisting line is attached to the back of the dipper and no bail is used. A bail sheave and forged case is supplied for use in case a double hitch is rigged.

The dipper handle is built up of two white oak sticks, each 7 inches by 18 inches and 36 feet long. It is armored with heavy 7-inch ship channels top and bottom, and on top is a bar 1¼ inches thick, counterbored for the nuts of the rack bolts, thus leaving a smooth surface for the slide of the yoke block. The rack is of cast steel, 2½-inch pitch, shrouded and bolted to the handle. The end castings for attaching dipper and braces are of steel.

The shipper shaft is of hammered steel, 5½ inches in diameter, with square sections for pinions and brake wheels. The pinions are cast steel, 13 inches in diameter, and the brake wheels, one on each end of the shaft, are 60 inches in diameter and fitted with brake bands lined with maple blocks. Both bands are connected to one lever, which has both hand lever and foot pad. The yoke block is of cast iron with a cast steel cap and slide. The cap is bronze bushed.

TRAVELING CRANE

A traveling crane is installed over the engines for moving heavy pieces of machinery. A 12-inch channel, extending from the boiler forward on each side, is supported by vertical channel posts secured to the cabin trusses on each side and forms the track for the crane. This track is spanned by two channels mounted on wheels running on tracks on the side channels. Two four-wheel trolleys, each carrying a 3-ton chain hoist, run on the thwartship channels, making it possible to pick up or place machinery in any part of the engine room.

The main hoisting line is a 1¼-inch wire rope and is made fast to the dipper and leads up over the boom point sheave and down under the heel sheave through the two sheaves on the swinging circle and back to the drum on the main engine. A guide sheave is located on the engine frame just forward of the backing drum to prevent the hoisting line from rubbing on the backing chain. The backing chain is 1¼-inch tested dredge chain and is made fast to the dipper handle at the dipper. It leads over a fair lead sheave free to turn about a vertical shaft in a bracket riveted to the front of the hull under the lip of the swinging circle base casting and then over a sheave which travels transversely on a shaft in the lip of the base casting, back through the casting and along an oak plank runway to the backing drum on the main engine. The swinging line leads from the rim channel of the swinging circle through two horizontal sheaves located aft of the swinging circle back to the swinging engine.

BOILER

The main boiler is of the locomotive firebox type, 6 feet 6 inches in diameter by 20 feet 6 inches long, and was designed particularly with a view toward the best possible economy in coal consumption after extended investigation into the coal consumption on other dipper dredges. The boiler was built for a working pressure of 150 pounds and has a 7-foot firebox, 5 feet high, flared to 7 feet 5 inches at the bottom, surrounded by a 5-inch water leg. There are 255 two-inch flues and a steam dome 3 feet by 3 feet. The ratio of heating surface to grate surface is 35.6:1. The stack is 3 feet in diameter and 20 feet high. The boiler is fitted with interlocking shaking grates and soot blowers. Draft is furnished by an exhaust steam jet in the stack. The boiler and steam lines are heavily lagged.

A feed water heater of the multicoil type is provided and operated by exhaust steam from the engines. A settling tank is also provided into which the feed water passes after being preheated in the boiler and into which the scale-forming material is precipitated before the water is liberated in the boiler. In this manner trouble from scale deposits in the boiler is eliminated. The feed pump and general service pump are both automatically controlled by pump governors. An auxiliary boiler of the vertical submerged flue type is provided for emergency use, such as operating spuds, pumps or generating set when the main boiler is out of commission.

ELECTRIC PLANT

The generating set is a 3½-kilowatt, 110-volt, direct-current, compound-wound generator directly connected to a 4½-inch by 4-inch vertical steam engine. The interior of the cabin is well lighted throughout with additional plugs for cutting in electric drills or extension lights for use in the watertight compartments in the hull. A row of lights is provided under the eaves on each side of the cabin for use when working a night shift, and two four-light clusters on the forward side of each spud well casing. The working area is further illuminated by a six-light cluster located on the point of the boom and facing down.

A steam capstan is located about amidships on each side of the cabin with 6-inch by 6-inch double-cylinder reversible engines installed below the deck in the hull. Two single-barrel hand capstans are located near the bow for convenience in handling lines from rock barges.

The cabin houses the machinery and no living quarters are provided, as it is the policy of this district to furnish separate quarter boats on which the crews live. In this way the heat, noise and discomfort incident to quarters on the dredge are eliminated. The cabin is of wood stiffened by steel trusses and is 80 by 30 feet. The cabin trusses act as additional stiffening for the hull. Roof purlins are carried on steel roof trusses. A ventilating monitor extends the entire length of the roof. Two coal bunkers are located at the after end of the cabin, each with a capacity of 15 tons of coal.

The operator's lever stand is arranged in a house on the port side, just forward of the main cabin with windows on three sides, allowing the operator free view in all directions. The forward spud throttle and brake levers, swinging engine throttle, backing drum ram throttle and hoisting drum ram throttle are banked as hand levers, with the main engine brake as a foot pedal and the main throttle and aft spud throttle overhead.

These dredges have proved very satisfactory. They have shown a capacity of 50 yards per hour in blasted rock and 200 yards per hour in gravel with a two-yard dipper, and have stood up well under severe conditions of digging.

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A Twin-Screw Bucket Ladder Dredger and a Single-Screw Hopper Barge For Tasmania

BY F. C. COLEMAN

Messrs. Ferguson Brothers (Port Glasgow), Ltd., have recently delivered to the Marine Board of Launceston the twin-screw bucket dredger and the single-screw hopper barge illustrated in the photographs.

The dredger is of the bow-well center ladder type with side shoots arranged for discharging dredged material over either side into hopper barges. She is constructed substantially throughout for dredging hard material and is fitted with two sets of buckets, one set for 23 cubic feet capacity, the smaller set for 13 cubic feet capacity. Steam is supplied from two cylindrical return multitubular boilers. The main engines are compound surface condensing, so arranged that one or both can work the dredging machinery.

The whole of the gear, tumblers and bucket backs are of cast steel, the hoisting gear for the bucket ladder is of the double brake system driven by a powerful steam engine on the builders' improved system. Powerful steam winches are fitted at the bow and stern for manipulating mooring chains and holding the dredger up to its work.

The hopper barge is a single screw flush deck vessel with forecastle, 155 feet long by 30 feet by 13 feet 6 inches, and has been constructed substantially throughout for receiving hard material. Hopper doors are arranged in the bottom of the vessel for discharging the material overboard.

Steam is supplied by one cylindrical return multitubular boiler. The main engines are compound surface condensing fitted aft in the vessel with complete equipment of auxiliaries. The engine and boiler are powerful enough to drive the vessel at a speed of 10 knots.

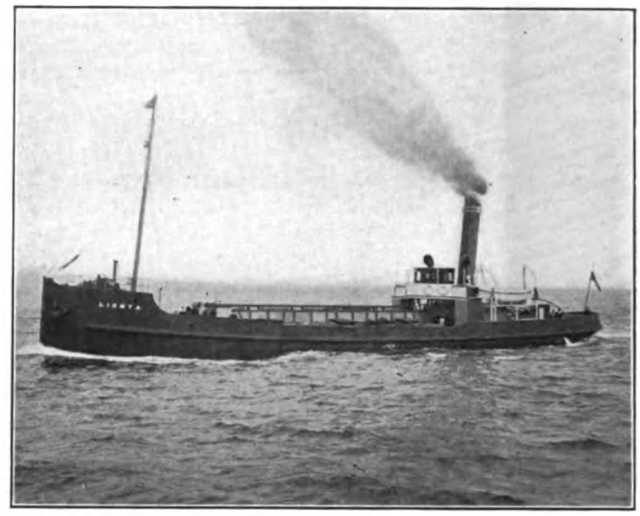

Fig. 2.—Single Screw Hopper Barge *Lienta*

A steam windlass is fitted on the forecastle deck and there is a steam winch on the deck forward of the hopper for lifting hopper doors. Sluices are arranged from the hopper to carry off the water. The vessel is fitted with electric light to give ample illumination throughout the vessel for dredging at night. There is a towing hook at the after end of the boiler casing with the necessary towing beam.

Accommodation for officers and men is fitted forward

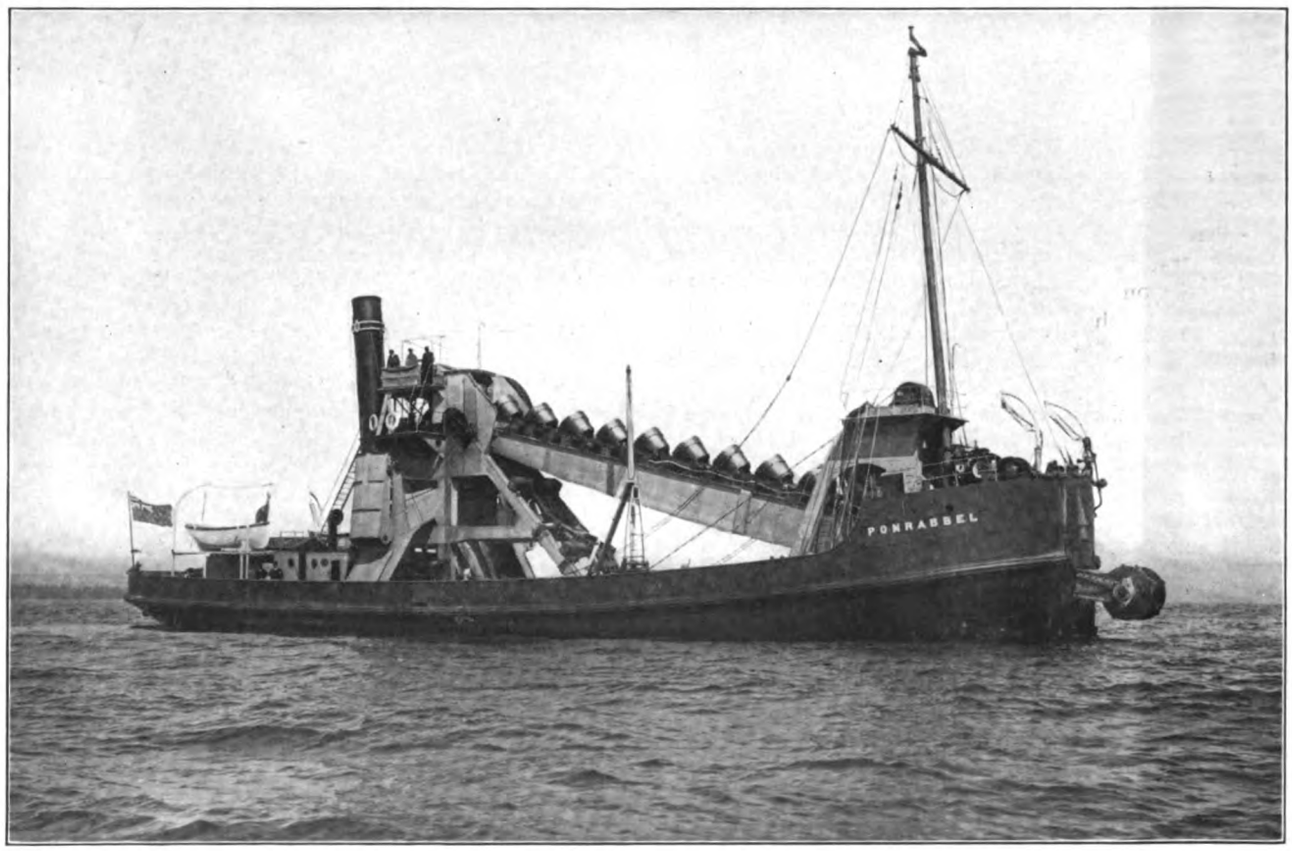

Fig. 1.—Bow-Well Center Ladder Dredger *Ponrabbel*

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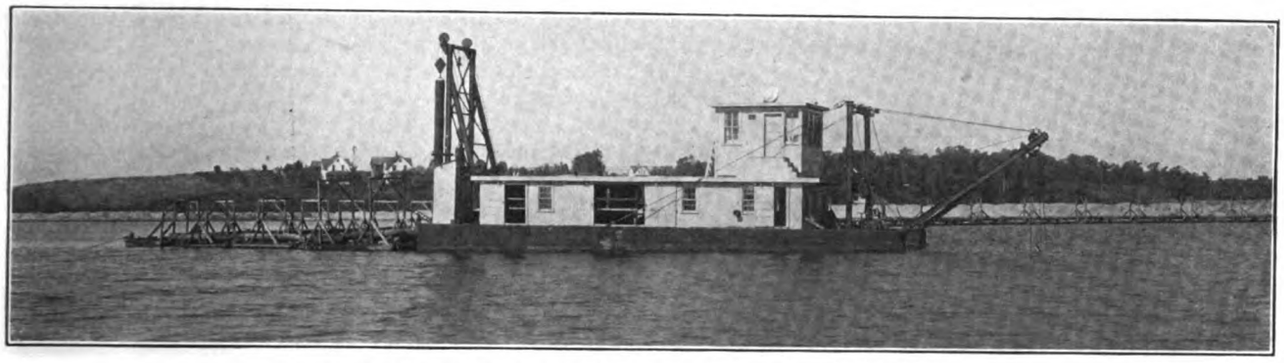

Fig. 1.—Fifteen-Inch Norbom Electric Dredge Operating in Lake Nokomis

and the galley and crew's lavatory are under the forecastle deck, the lamp room and officers' lavatory being under the bridge deck.

Both the dredger and hopper barge have been built, according to Lloyd's highest class, by Messrs. Ferguson Brothers (Port Glasgow) Ltd., under the direction of Mr. W. H. Hunter, consulting engineer, of Manchester.

Electrically-Driven Hydraulic Dredge

Last year the Park Board of the city of Minneapolis were undertaking improvement work on an extensive scale around Lake Nokomis, consisting of various kinds of excavation and filling-in, work eminently suitable for hydraulic dredging. The contract for this work was let to the Northern Dredge & Dock Company, of Duluth, Minn., and a 15-inch electric dredge (Fig. 1) for this work was built by the Norbom Engineering Company of Philadelphia, Pa.

While electrically driven centrifugal pumps have already been used successfully for many years, the electrically driven dredging pump presents certain features that must be given an earnest study if the dredge is to be a success. A small and fast rotating runner, such as is necessary with a direct connected motor, is very inefficient and soon wears out. Even the speed of an extremely slow speed motor, say, for instance, 350 revolutions, is a high speed for a dredging pump (except the minor sizes), and such motor is undesirable on account of its high cost, low efficiency and its bulk. A one-speed motor, whether of high or low speed, is too "rigid" to be desirable for a dredge that may one day be pumping against a 5-foot lift and 200 feet of pipe, and another day with a 25-foot lift and 2,000 feet of pipe line. If the motor and pump have been designed for effective work for the latter condition, it is practically useless on the former. If the speed is varied by resistance in the circuit through a controller, the waste of power is excessive. The only type then for direct connected motor and pump is a multiple speed motor, to which, however, there are many objections, principally its intricate construction or wiring, and its high cost.

The dredge above referred to is fitted with a comparatively large pump runner, 54-inch diameter, insuring an efficient working length of the vanes. It is driven at two speeds, about 300 and 250 revolutions by a 500 horsepower synchronous motor running at 720 revolutions, the speed reduction as well as speed change being effected through two sets of cut helical gears running in an enclosed casing, and oil lubricated. Fig. 2 shows this pumping unit assembled. A lever on top of the gear box, connected with a rigid clutch, will lock the gears in position for one speed or the other. With the synchronous motor, with a pump of ample and efficient size, and with this speed change device, the loss of efficiency of which is less than 2 percent, this unit may be considered as efficient and economical as can be had for dredging purposes, and the actual results show that for a period of over two months last fall the power consumption, with a pipe line varying from 500 feet to 2,000 feet, averaged from ½ to ¾ kilowatt hour per cubic yard of excavation. This consumption includes also the power taken by the auxiliary machinery, such as the cutter and winding machinery, water service pump, electric lights, etc.

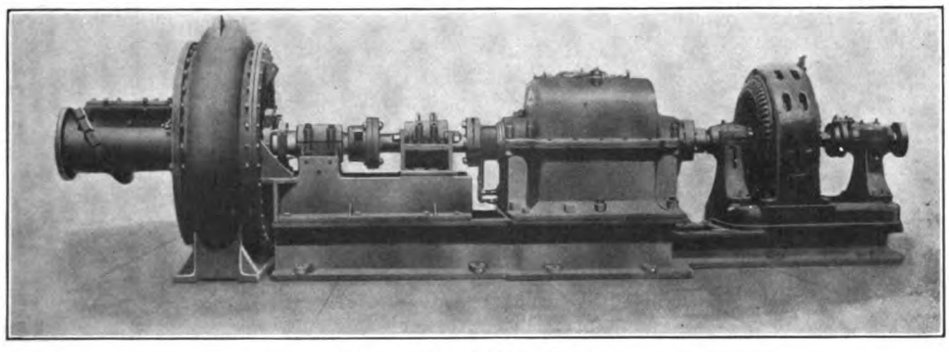

Fig. 2.—Motor-Driven Pump

The two speeds are sufficient, and are so proportioned that one is used with pipe lines up to 1,200 or 1,500 feet, and about 10 to 12 feet lift, while for more than this the high speed gears are being used. Under average conditions the dredge excavated 5,600 cubic yards per day, official measurement, while the daily maximum ran over 7,000 cubic yards in 24 hours.

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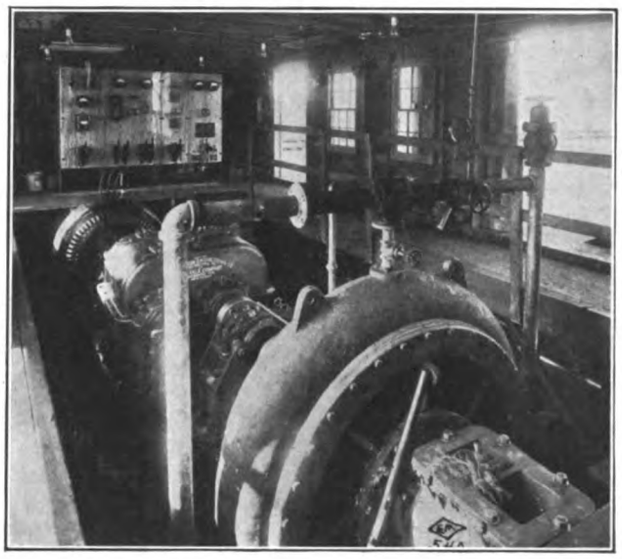

Fig. 3.—Interior of Dredge

The cutter machinery is operated by a 50 horsepower slip ring type motor, and is fitted with the Norbom Engineering Company's standard type cutter with interchangeable parts, as shown in Fig. 1. The operating or winding machinery is driven by a 30 horsepower slip ring type motor, and consists of five drums with frictions and brakes, and two winch heads.

A water jet exhauster operated from an auxiliary pump is used for priming the main pump, and there are provisions for fire service, water sealing of stuffing box on pump and of the ball joint on the ladder, and for pumping out the bilges.

The current is 2,300 volt alternating, three-phase, sixty cycles, used without transformation on the three principal motors. It is transformed to a low voltage for the service pump motor, and a motor-generator set installed for the purpose of giving direct current to a 6,000 candlepower searchlight; on this circuit is also inserted arc lights and incandescent lamps as well as an electric horn for signal purposes.

The hull is 80 feet long, 24 feet wide and 7 feet deep, and draws an average of 40 inches of water.

The photograph (Fig. 3) showing an interior of the dredge, was taken while the dredge was running, indicated by the blurred coupling on the pump shaft, and the rotor in the main motor. It is interesting to note how steady the machinery must have been running to allow of such sharp definition in the picture.

Government Dredges for Improving the Arkansas River

Two steel hull, stern wheel, shallow draft, 24-inch pump dredges, the *H. S. Taber* and the *Robert McGregor,* one of which is illustrated on this page, were built recently by the Dubuque Boat and Boiler Works, Dubuque, Iowa, for government service in improving the Arkansas River. The dimensions of the hull are as follows: Length between perpendiculars, 192 feet; length over all, 206 feet 9 inches; beam, molded, 44 feet 4 inches; depth, molded, 7 feet; draft, loaded, 3 feet 2 inches; displacement, loaded, 640 tons.

Two longitudinal and three transverse watertight bulkheads divide the hull into twelve watertight compartments. The main deck is of steel and the main deck house and the upper deck house of wood.

Steam for operating the dredge is furnished by three boilers of the Lyons type built by the Dubuque Boat & Boiler Works for a working pressure of 200 pounds per square inch. Each boiler has a grate surface of 45 square feet and a heating surface of 1,685 square feet. Induced draft is used and is supplied by three fans mounted on a platform over the boilers and connected to the uptake with a discharge leading into the base of the stack. The fans are 60 inches diameter and the engines 4½ by 5 inches of the inclosed, self-oiling type running at 535 revolutions per minute.

The propelling engines are simple engines 24 inches diameter by 48 inches stroke, built by Gillett, Eaton & Squire, Lake City, Minn., and fitted with Eaton independent inside valve drive. This drive is taken from the

Government Dredge *H. S. Taber,* Built by the Dubuque Boat and Boiler Works

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pitman and thereby does away with the old style outside cam fitted to the shaft, with its necessary cam rods and brackets. The paddle wheels are arranged on the same shaft and are each 12 feet diameter by 12 feet long. The actual weight of the wheels is 62,000 pounds.

The main dredging pump is a 24-inch centrifugal, single suction pump of the shrouded type driven by a vertical triple expansion engine with cylinders 15, 22½ and 36 inches diameter and 18 inches stroke. The pump was built by the Morris Machine Works, Baldwinsville, N. Y. The condenser is of the Wheeler type with a cooling surface of 1,650 square feet.

One hauling engine is mounted on the port and one on the starboard side of the dredge, the hauling winches being manufactured by Williamson Bros., of Philadelphia. Steering is by four balanced rudders operated by an S. J. Gardner steam steering gear.

The auxiliaries are very complete, including two Blake & Knowles horizontal duplex 8-inch by 4-inch by 10-inch feed pumps, a horizontal simplex 8-inch by 14-inch by 12-inch air pump of the same make, and a centrifugal circulating pump, driven by a 6-inch by 6-inch simple engine direct connected. A 12-inch centrifugal jet pump driven by a Kerr turbine of 142 brake horsepower running at 1,650 revolutions per minute is installed, producing a pressure of 34 pounds on nozzles in the suction head. The auxiliaries also include a Reilly multicoil heater in both the boiler and engine rooms, a Griscom-Russell 3-inch grease extractor, Lynn-Superior filters and a Schutte-Koerting film heater for the hot water line. Fischer pump governors are installed and the discharge lines are fitted with pop safety valves discharging back into the suction.

The electric plant consists of a 15-kilowatt, direct connected, Kerr turbine-driven generator, operating at 3,600 revolutions per minute, which supplies power for lighting and a number of machine tools. The refrigerating plant was supplied by the York Manufacturing Company, York, Pa., and has a capacity of one ton of ice per 24 hours.

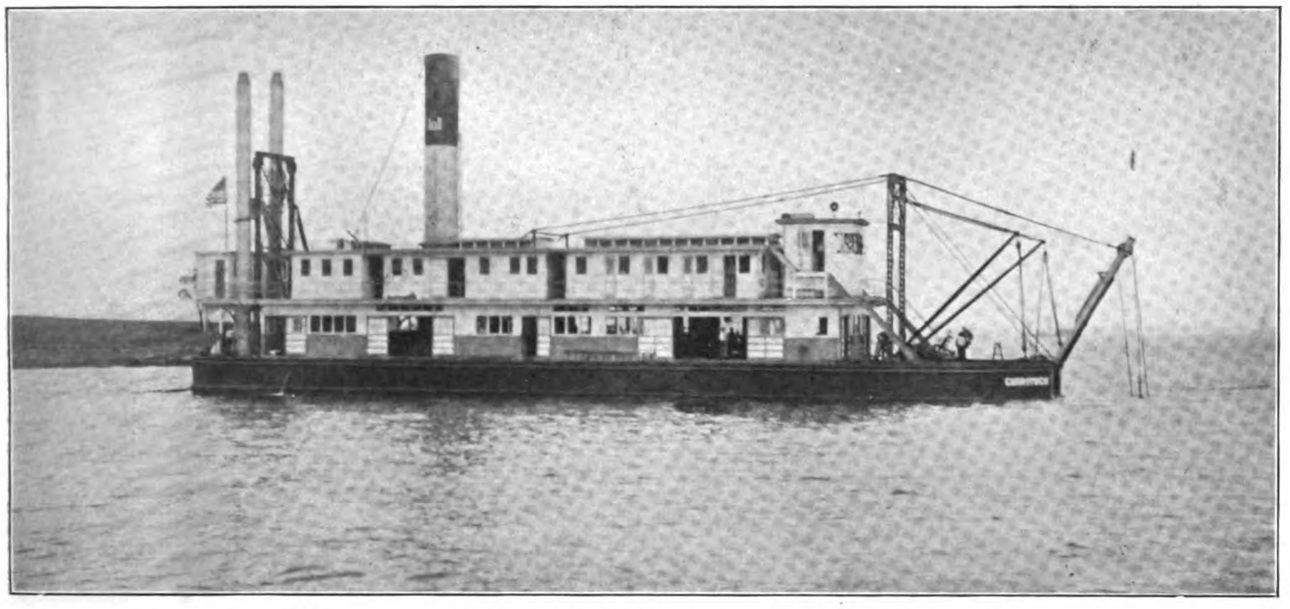
On trials the main propelling engines developed a maximum of 1,175 indicated horsepower with cut-off at seven-sixteenths of the stroke.

Recent Ellicott Pipe Line and Sea-Going Hydraulic Dredges

The output of the Ellicott Machine Corporation, Baltimore, Md., for 1914, included a number of interesting pipe line and sea-going dredges. Two 20-inch steel hull pipe-line dredges were built which were duplicates in every respect. One of these, the *Currituck*, is illustrated on this page.

These dredges are of the cutter type, with a single sand-pumping outfit. The pumping machinery consists of a centrifugal pump directly connected to a triple expansion fore and aft engine. The cutter for loosening the material to be dredged is driven by a double condensing engine mounted on the ladder at its inboard end. The feeding into the cut is by means of wire rope haulage on each side of the bow, with pivoted stern, and the advance forward is accomplished by two spuds. The hauling drums are driven through a lay shaft and gearing by double reversible condensing engines.

Steam for operating the machinery is supplied at 200 pounds pressure by four Scotch boilers. The aggregate indicated horsepower of the machinery under ordinary service conditions is about 1,000 and the capacity of the dredge 750 cubic yards per hour place measurement. The hull of the dredge is 150 feet long overall, 40 feet molded beam and 10 feet 6 inches extreme depth.



20-Inch Pipe Line Dredge *Currituck*, Built by the Ellicott Machine Corporation

This company also built during 1914 the United States sea-going dredge *Absecon*, now at work improving Absecon Inlet, N. J. This dredge is about 160 feet long over all, 35 feet beam, 12 feet deep, and will carry in her hoppers about 300 yards of sand.

The *Absecon* is built on the Isherwood system with side dump doors, hydraulically operated. She has two Almy, Class E, watertube boilers, designed for 250 pounds working pressure. She is a twin screw boat propelled by two compound condensing engines with cylinders 12 and 24 inches diameter by 18 inches stroke, designed for 120 revolutions per minute. The pumping outfit consists of a 16-inch sand pump driven by a compound engine with cylinders 12 inches by 24 inches diameter by 14 inches stroke. There is a full equipment of electric lights, steam steering

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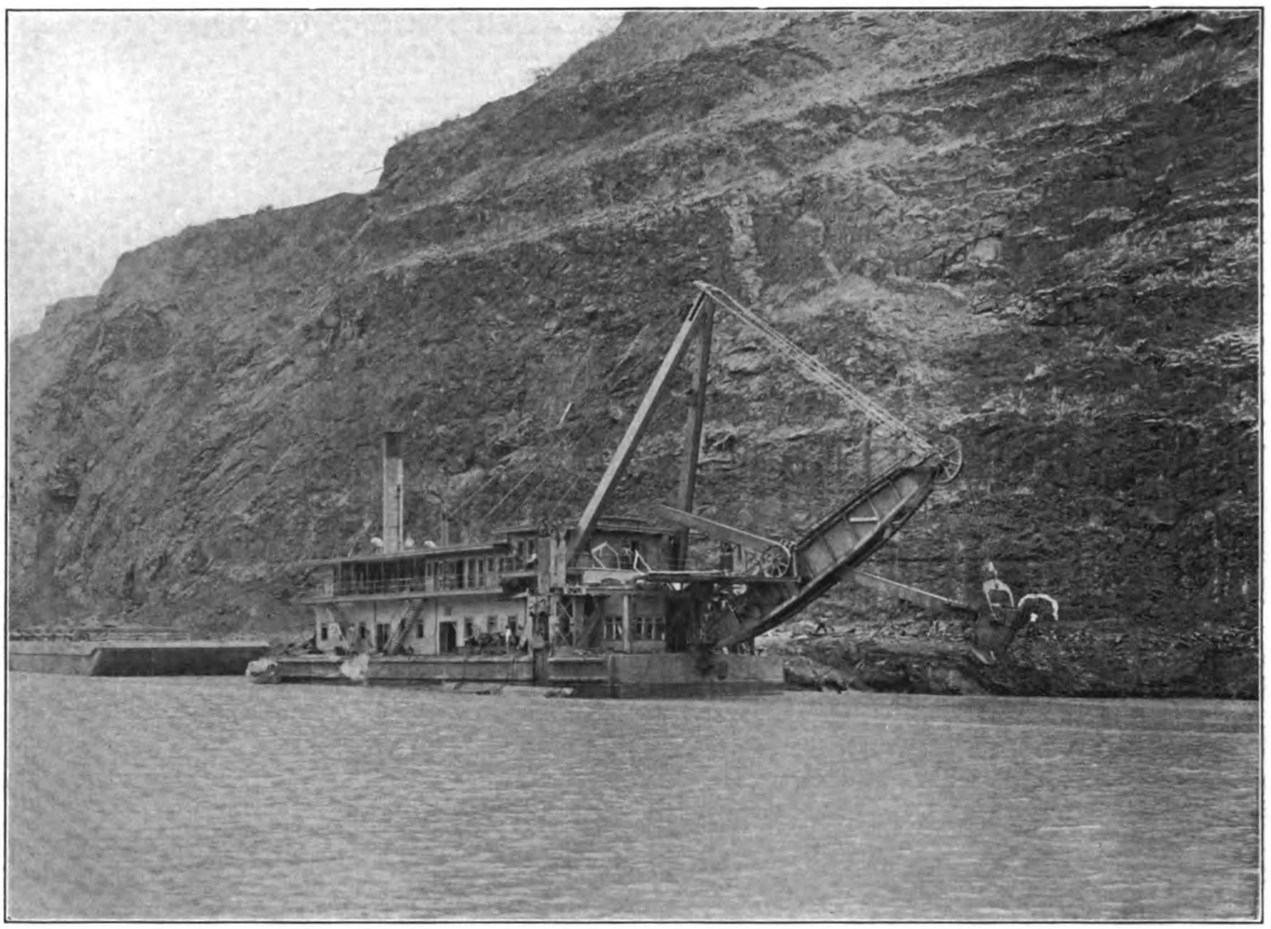

Fig. 1.—Powerful Dipper Dredge *Gamboa*, Built by the Bucyrus Company, at work in the Culebra Cut on the Panama Canal

gear and auxiliaries, making the dredge a completely equipped sea-going vessel.

Another sea-going dredge which the Ellicott Machine Corporation has just completed for government service in the Galveston, Tex., district, is the *Comstock*, 165 feet long overall, 35 feet beam, molded, and 17 feet depth with a capacity for 500 cubic yards of sand on a 14-foot 6-inch draft. She is a single screw boat propelled by a compound engine with cylinders 18 and 36 inches diameter by 24 inches stroke, supplied with steam by two Scotch boilers equipped for burning oil and fitted with Eckliff circulators.

The pumping machinery consists of two 12-inch by 24-inch by 14-inch compound engines which drive two 15-inch dredging pumps. The condensing plant is independent of the main engines and has 1,700 square feet of cooling surface. The dredge is equipped with steam steering gear, an electric light plant, evaporating plant, and an ice-making plant, and has very commodious quarters for the officers and crew.

The Most Powerful Dipper Dredge in the World

The two 15-yard dipper dredges *Gamboa* and *Paraiso*, built for service on the Panama Canal by the Bucyrus Company, South Milwaukee, Wis., and described in detail in our May, 1913, issue, exceed in both size and power any other dredges of the same type that have ever been built. They have proved their value in working under severe conditions in the Culebra Cut, fighting the slides which have so frequently menaced navigation since the canal was opened.

Fig. 2.—The *Paraiso* Fighting the Curcuracha Slide in Culebra Cut

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Ever since the dredges started work, they have been in the heaviest kind of digging, consisting of an outcropping dyke of trap, which is unusually hard, metallic rock. An idea of the difficulty of this digging can be gained from the fact that during a thirty-day test of the *Paraiso* a day did not pass that the dredge did not dig up from half a dozen to two dozen boulders weighing from 10 to 30 tons apiece; of such size, in fact, that they had to be blasted on the dipper before being placed on the scows. The largest boulder encountered so far weighed about 50 tons. When the dredges were first put in operation their speed was set at from 90 to 120 seconds per cycle. Within a week the dredges were speeded up gradually until, when they were turned over to the dredging division, 45 seconds per cycle was attained and set as normal. This was while digging to a depth of 40 to 50 feet.

The output of the dredges has likewise been gradually increasing. The average of 3,000 to 5,000 cubic yards per day of 16 hours first obtained has been increased to an average of 9,000 to 10,000 cubic yards. The monthly output has also been increasing. The official figures for the *Paraiso* from June to November, 1914, are as follows: June, 72,700 cubic yards; July, 84,700 cubic yards; August, 96,400 cubic yards; September, 109,800 cubic yards; October, 125,000 cubic yards, and November, 140,000 cubic yards.

Both dredges have used their 10-yard rock dippers for this work, and they are designed to dig to a depth of 50 feet below the surface of the water.

The dredges are duplicates, except in a few minor details. The main hoisting machinery consists of horizontal, twin tandem, compound, condensing engines, compound geared to heavy spur gears mounted on the main hoisting shaft which carries the drums. The drum is of the differential type which is characteristic of high-powered Bucyrus dredges. The shape permits the maximum digging force and the slowest speed at the time when the dipper is digging and the angle between the hoisting rope and the dipper handle is the sharpest. As the dipper is hoisted the rope winds on to the large diameter of the drum, which of course increases the speed when this is most desirable and when the maximum bail pull is not required.

10-Yard Dipper Dredges on the Cape Cod Canal

The Cape Cod Canal is now an accomplished fact and has been described before, but to refresh the memory of some we may repeat that it is 8 miles long and has a designed width of 100 feet on the bottom, and a depth of 25 feet. As in the Panama Canal, dry excavation was employed to take off the material above the waterline and hydraulic and other dredges were employed to some extent in deepening the entrances. For the main driving of the heading from each end, two powerful dipper dredges, the *Governor Herrick* and *General Warfield*, were employed, one of which is shown in Fig. 2 and a detail view of the boom in Fig. 1.

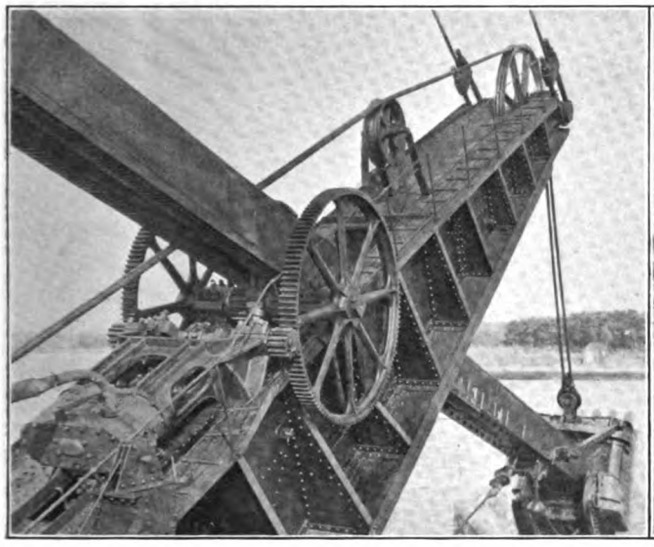

Fig. 1.—Detail of Boom of Ten-Yard Dipper Dredge

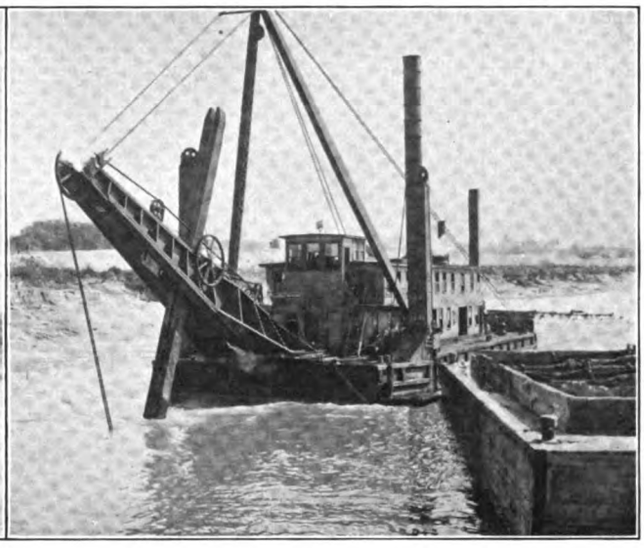

Fig. 2.—Dipper Dredge *Governor Herrick* in Operation on the Cape Cod Canal

Although the material to be excavated was of a sandy and earthy nature on top and in the entrances, the bulk of the channel beneath the surface was more difficult and contained much glacial drift and boulders. For this class of work, undoubtedly, the choice of the dipper type of dredge was a wise one. Not only could the dipper dredge do more effective work in such material than any other type, but it is eminently suitable for driving the heading and to dig its own flotation with a high bank ahead. Indeed, it may be doubted if any other type of dredge could do the work at all. A dredge of the hydraulic type could not handle the boulders, nor was any place of deposit available, and the bucket-ladder type would also have difficulty with the boulders and of working effectively in such a confined space.

All the material was loaded into barges and dumped at sea. The barges used contained 1,000 cubic yards each. By shifting the dredge from one side of the cut to the other when moving up, sufficient space was excavated ahead to permit the barge to come alongside, on either side alternately, and by passing the barge around the stern of the dredge both ends of it could be loaded.

The dredges are alike, and are of the following dimensions: Length of hull, 130 feet; beam, 42 feet; depth, 12 feet; size of main engines, 18 inches by 24 inches; size of swinging engines, 10 inches by 14 inches; depth to which dredge can work, 40 feet; type of boilers, Scotch marine; diameter of boilers, 9 feet 8 inches; length of boilers, 10 feet 6 inches; number of boilers, 2.

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The hull is of steel with square bilges, strongly reinforced where necessary at front end and in way of spuds. It is stiffened longitudinally by two fore and aft trusses of depth to main deck. These with the strength of sides are ample for all purposes, so that the structural strength is contained entirely within the body of the hull. There are no deep trusses above deck as are frequently used in the older type of dipper dredge, and which are a survival from the days of wooden hulls and a crane-post.

The forward spuds are of steel and are operated by independent engines. There are two stern spuds mounted as oscillating or trailing spuds, also worked by separate engine. The boom, as will be seen, is of the well-known Robinson patent "Atlantic type," with straight members and solid turntable. It is fitted with a pair of reversible engines geared to the shipper shaft, to give a power feed to the dipper. This was introduced to give better maneuvering power when handling boulders, and to spot the dipper when dumping into barges at varying range, two conditions that were especially encountered on the Cape Cod Canal work.

The main engines and hoisting machinery are of very substantial design, all the gearing being of steel and the first motion gears machine-cut. The hoisting drum is conical, fitted with Robinson's system of double parallel hoisting ropes for a direct pull of 200,000 pounds. The band friction is steam operated and of exceptionally large bearing surface, being 18 inches wide, thus insuring durability and cool running. Special attention is paid to ease of handling without manual effort, all the motions being controlled by steam cylinders, with floating levers and compensating links, so that the movement of the piston corresponds to the movement of the hand. The main throttle is also of the balanced type, so that the engines, notwithstanding their great pull of 200,000 pounds, are extremely sensitive and quick and respond instantly to the levers. A speed of 30 to 40 seconds per dipper load can be made under favorable circumstances.

For handling the barges, two independent deck winches are fitted, each with three drums for wire rope lines. Suitable fair-leads are disposed about the deck so that the barges may be moved or held in position as required.

Comfortable crew quarters are fitted on the upper deck with every convenience, including electric light, and, altogether, these are two of the best equipped dipper dredges along the coast.

The work done by these two dredges was very satisfactory. Working three eight-hour shifts per day, the *General Warfield* has averaged nearly 100,000 cubic yards per month. In hard material and boulders the output would be somewhat less. In June and July, 1913, the *Governor Herrick* made a record of 251,000 cubic yards. The best month was 131,000 cubic yards and the best ten days 60,000 cubic yards.

These dredges were built by the American Locomotive Company under the designs and patents of A. W. Robinson, M. Inst. C. E.

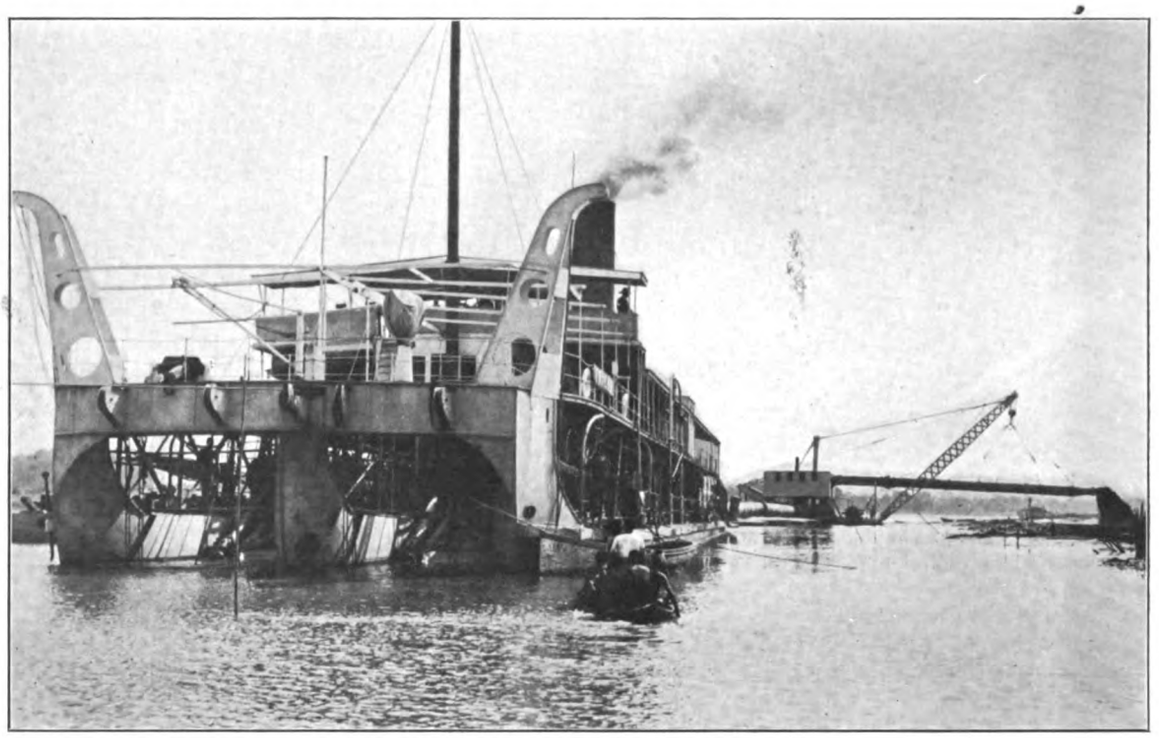

Fig. 1.—Forty-Two-Inch Hydraulic Dredge *Foyers* at Bengal Waterways, India

42-Inch Hydraulic Dredge Foyers

The remarkable hydraulic dredge illustrated in Figs. 1 and 2 is in use in the inland navigation channels of Bengal, India. These river channels are very numerous and extensive, especially in the deltaic region of the Ganges. There are about 4,000 miles of inland waterways in Bengal navigable for steamers of a fairly large class. Many of these waterways are tidal for a considerable distance from the sea, and although they are beyond the reach of the sandy alluvium of the Ganges proper, they are obstructed in places by dense mud shoals and banks, which only require a moderate length of dredging to render good navigation of a fairly permanent character. To meet this condition the hydraulic dredge *Foyers* was built and put in service.

The *Foyers* was designed to be of the largest possible capacity that could navigate the rivers, and to be self-propelling so that it could readily go from place to place. There are two pumps, each with 30-inch inlet and outlet, connected to four suction pipes 24 inches in diameter, and one discharge pipe 42 inches in diameter. The distinguishing feature of this dredge is that it has been de-

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signed for a straight forward feed to cut a channel in stiff clay or mud the full size of the section of the hull to permit its passage. For this purpose a battery of four cutters of special design for forward feed is mounted in two wells in front, the vessel being formed with three bows, as shown in illustration. The forward feed is accomplished by two wire rope anchorages set out ahead and connected to winding engines. The capacity is so great that a channel large enough to pass the dredge can be excavated at the rate of 200 to 300 lineal feet advance per hour. Special provision is made for the disposal of the spoil ashore by a shore pipe suspended from a terminal pontoon. This is towed astern by a short length of floating pipe in flexible sections.

These two pumps are driven by two sets of triple expansion engines of marine type having cylinders 17 inches by 27 inches by 46 inches diameter by 24-inch stroke. The boilers are of Babcock & Wilcox marine type and four in number. The vessel is propelled by triple screws.

The four cutters are driven by two sets of horizontal compound engines, placed on forward deck through the medium of gearing so arranged as to permit the cutters to rise and fall. The cutters are of propeller form with blades specially shaped to give proper clearance angle and a drawing cut.

All the movements of the dredge are controlled from a pilot house on the upper deck. The operation of the dredge is very simple.

This dredge was designed by A. W. Robinson, of Montreal, to the requirements of Mr. O. C. Lees, Superintending Engineer of the Department of Public Works in Bengal.

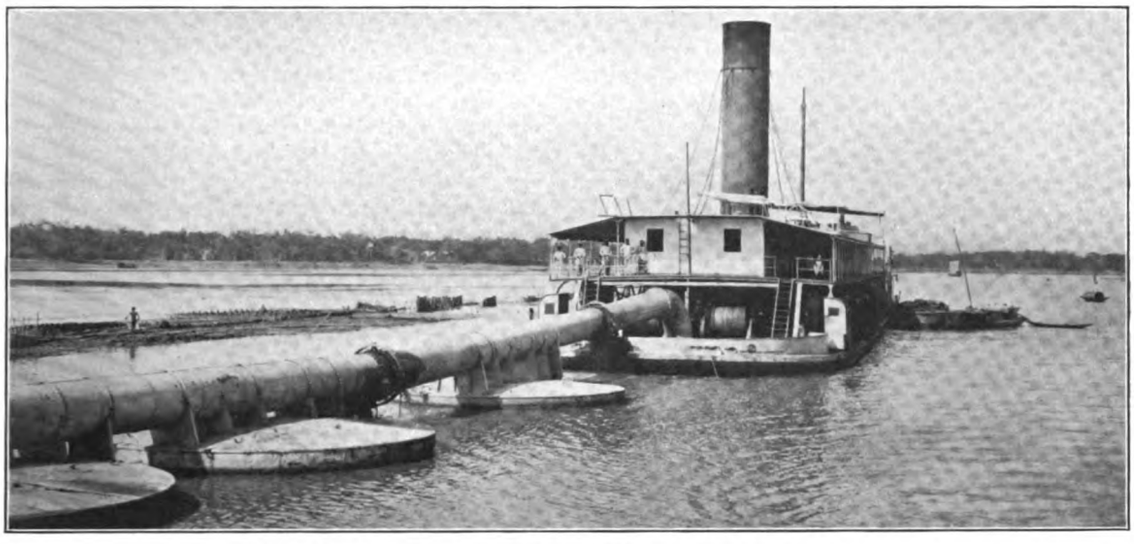

Fig. 2.—Stern View of the *Foyers*, Showing Semi-Circular Stern

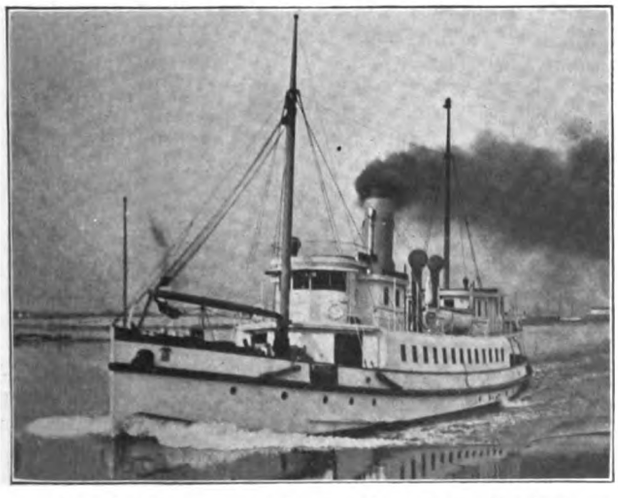

Fig. 1.—Quartermaster Steamer *Gen. S. B. Holabird*

Quick Repairs to Damaged Dredge

Two government vessels, the U. S. Quartermaster steamer *General S. B. Holabird* and the U. S. Engineers' Department dredge *Wahalak*, collided recently in Mobile Bay while the *Holabird* was bound to Fort Morgan, and the dredge, in tow of two government tugs, was bound to Mobile to commence work on the ship channel in Mobile River above the city. The *Wahalak* was hauled out on the Gulf Dry Docks Company's ways in a leaking condition, but the *Holabird* was not damaged, as the collision was head-on.

Bids for repairing the dredge were received from the different repair shops in Mobile. The lowest bid was from the Home Industry Iron Works, amounting to $3,900 (£800), and the job was finished in forty-eight hours. It is surmised that the cause of the collision was that the *Holabird* struck shallow water, which caused her to sheer.

L. E. G.

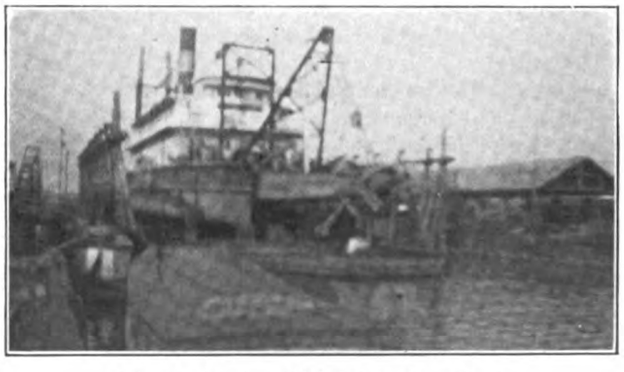

Fig. 2.—Dredge *Wahalak* in Dry Dock

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Notes on the Conversion of Cargo Vessels into Bulk Oil Carriers—III

BY F. K. RUPRECHT *

The tank deck will form the top of the pump rooms, if they are located in the cofferdams. A trunk will pass through this deck for access to the pump rooms, and the connection of trunk to deck must be made oiltight. Since the pump rooms are on only one side of the vessel, that portion between the shell and the centerline bulkhead on the one side only need be made oiltight. On the other side the original deck will be left between the ship's side and the expansion trunk bulkhead, but that portion between the trunk bulkhead and the centerline bulkhead will be removed except that the above-mentioned shelves will remain on the centerline and transverse bulkheads. The portion between the shell and the expansion must have large drainage holes cut in it. In the forward and after cofferdams the entire deck will be removed, as it interferes greatly with the ventilation unless many large openings are cut, which would prove to be expensive and dangerous to the crew.

Upper Deck

The upper deck will be oiltight over the expansion trunk and cofferdam only unless the spaces alongside of the trunk bulkheads are used as summer tanks. In this case the deck will have to be oiltight throughout the cargo and cofferdam spaces. The deck beams will be cut at the expansion trunk bulkheads and bracketed to them. They will also be cut and bracketed to the centerline bulkhead.

This deck, as a rule, is the strength deck, and only shelter or awning decks are fitted above it. All the oiltight hatches will be fitted on this deck except in a shelter deck vessel where the summer tank hatches will be on that deck. Ample compensation must be made for the openings cut for the hatches, and it will be found cheaper to do this by fitting heavy plates between ¾ inch and 1 inch thick instead of trying to fit oiltight doublings on the old deck plates. The old cargo hatches will have to be plated over by fitting new beams between the trunk bulkheads and the centerline, or as required to take the deck plating In view of this new plating required, and the heavy plating for compensation, it will be found advisable to fit an entirely new deck over the expansion trunks. A narrow, heavy plate will be fitted to take the upper angles of the centerline bulkhead, and a heavy plate will take the hatch coaming bounding angles. All plates will have double riveted laps and butts, except the heavy compensation plates, which will be fitted with single butt and edge straps on the top side. The other plating will be of the ordinary weight required by the rules.

If the 'tween decks are used as coal bunkers, the old plating between the trunk bulkheads and the shell can remain intact, but hatches will be fitted for access to bunkers and for trimming purposes. If, however, oil is to be carried in some of this space, the frames will have to be cut at the deck and a flanged plate or angle fitted in the same manner as on the tank deck. If the vessel is a two-deck vessel, this connection to the shell is all ready tight. Hatches for the summer tanks will also be cut in this deck and heavy compensation plates must also be fitted as around the other oil hatches.

The cofferdams will extend up to this deck for the entire width of the vessel, and so the plating must be worked oiltight over them and for a few frame spaces forward and aft of the bulkhead forming them. In any vessel where this deck is not the watertight weather deck the frames will be cut and flanged plates fitted to shell and deck as on the tank deck.

Pump Room Construction

As stated before, the best location for the pump rooms is in the large cofferdams forward and aft of the engines and boilers. This simplifies the construction and insures a dry pump room. There are two types of construction that can be used—i. e., the suspended floor or that with the pumping flat built on the floor plates.

In the suspended type we keep the sea valves outside of the pump rooms and use less space. In this type the floor is built at any desired height and consists of strakes of plating of the same weight as the lowest bulkhead plating, connected to the centerline and one of the transverse bulkheads by two small single riveted or one large double riveted angle. The plates are cut out in way of the frames, and the angle or angles connecting the flat to the shell are stapled around them. Brackets are fitted from the frames to the flat top and bottom, being double clipped, single riveted or single clipped with double zigzag riveting to top, and connected to transverse stiffeners in line with the frames on the bottom. These stiffeners will be the same kind and size as the verticals on the bulkheads, and will be bracketed to the centerline bulkhead. If the vertical stiffeners on this bulkhead come on the pump room side, they are best cut in way of the flat and the angles fitted continuously. In this case the stiffeners will be bracketed top and bottom to the flat and transverse stiffeners respectively. It will, however, usually be possible to arrange the pump room and stiffeners on alternate sides of the centerline bulkhead. The same applies to the transverse bulkhead which forms the other side of the pump room, for the construction is simplified by fitting the vertical stiffeners outside the pump room. In this case only the horizontal bulkhead stiffeners are in the pump room, and these involve no extra consideration because of their location.

The horizontal stiffeners on the centerline bulkhead will be cut at and bracketed to the bulkhead which forms the third side of the pump room, instead of being carried through and bracketed to the cofferdam bulkhead. This former bulkhead will be of the same construction as the other transverse bulkheads, but will extend only to the pump room flat, to which it will be connected by a large double riveted angle. The vertical stiffeners will be on the inside and bracketed by brackets and double clips single riveted or single clips double riveted to the flat. Horizontal webs will be carried at the stringer levels from the pump room bulkhead to the cofferdam bulkhead at the centerline bulkhead and at the shell.

Since this is the cofferdam space, these webs will have large lightening holes cut in them for drainage and access. On the cofferdam bulkhead the vertical stiffeners will, as a rule, be placed on the opposite side from the horizontal webs, but if necessary the latter may be run intercostal. Stanchions will be fitted under the pump room from the transverse flat stiffeners to the strips of plating on keelson or to the floor plates. The pump foundations will consist of angles and plates to suit the work as designed.

The tank deck will form the top of the pump room and a trunk will pass through this deck to give access and light and air. This trunk may be arranged so that one side is formed by the shell, in which case only three sides need be built, or an ordinary four-sided trunk can be installed in a suitable location. The size should be ample for access and should have a bolted flat top which can be re-

* Associate Member Society of Naval Architects and Marine Engineers.

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moved for the purpose of taking out the old pumps and installing new ones or parts. The trunk will be oiltight to a height of about 18 inches above the upper deck and watertight the rest of the height. Skylights and ventilators will be fitted on the top plate, all of which should be capable of being closed watertight. One ventilator should be carried down to about 6 feet above the flat to act as a downtake for fresh air, and the other will act as an exhaust.

A watertight door will be fitted at the weather deck. If desired, in a shelter deck vessel another door may be added in the shelter 'tween deck.

If the pump room flat is to be laid at the tank top level a complete bulkhead will have to be built. This will involve the removing of a floor plate and adding of much extra weight of material. In this case the flat need not be oiltight and can be made of portable sections of checkered plate.

If the pump room is situated in one of the cargo tanks the flat will have to be laid upon the floor plates because of the sea valves. This tvpe also involves a complete extra bulkhead, but the expansion trunk may be used as the access trunk. An entrance with bolted top plate skylights and ventilators will be fitted on the weather deck.

Cofferdams

As already stated, the foremost and the aftermost cofferdams will be two frame spaces in length, and the amidship ones forward and aft of the machinery spaces will be five or six frame spaces to allow room for a pump room in each. (See Figs. 3 and 4, May issue.)

The cofferdam bulkheads will be of the same construction as the cargo transverse bulkheads, but the stiffeners will be arranged on the side most suitable. The bulkheads of the former cofferdams will have the vertical stiffeners on the inside and the brackets at the bottom will be clipped to the bottom plating and the floor plate of the intermediate frame. The best way is to remove this intermediate floor plate and carry flanged brackets between the bulkheads double riveted to the vertical stiffeners and clipped to the bottom shell plating. The shell rivet holes of the intermediate frame must be plugged with rivets which will be chipped flush in way of the bracket clips.

Other flanged brackets will be fitted between the two bulkheads as called for by Lloyd's. The bulkheads will be continuous from bottom plating to the upper deck. The stringers will be cut at the bulkheads and a solid rectangular bracket will be carried from bulkhead to bulkhead. This bracket will be the same width as the stringer brackets to the other bulkheads and clipped and riveted in a similar manner.

The bulkheads of the amidship cofferdams will have their vertical stiffeners on the outside, and no bulkhead to bulkhead brackets will be fitted. The stringer and horizontal stiffener brackets will be of the same type as in the cargo tanks.

Centerline Bulkheads

The longitudinal centerline bulkhead will be continuous and oiltight throughout the tanks and cofferdams. It will extend from the top of the centerline keelson to the top of the expansion trunk. To avoid any abrupt decrease of strength, this bulkhead will be ended with buttresses in the forward dry hold, cross bunkers, engine room and the after dry hold. In the engine room a special arrangement must be made because it would be impossible in most cases to fit a large buttress in this space. In one case the engine room bulkhead was specially stiffened but no buttress was fitted, and this will be the usual method.

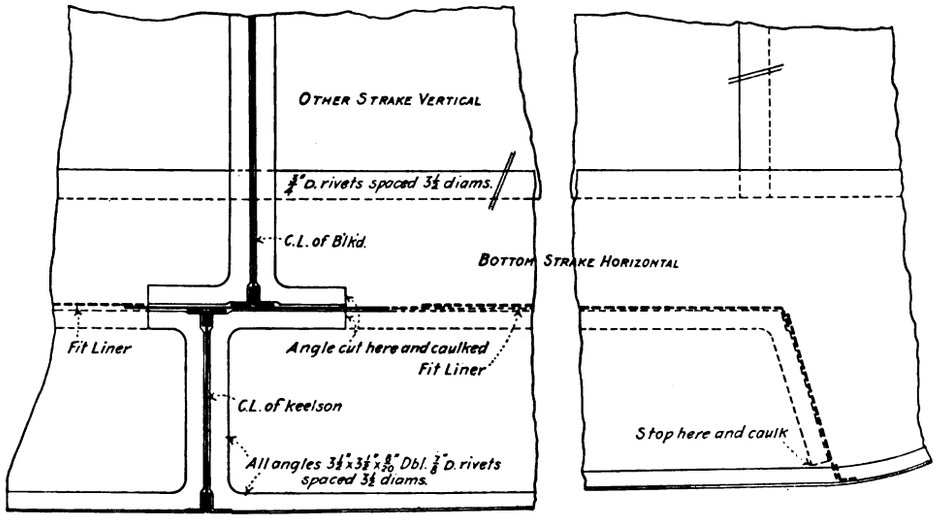
Other Strake Vertical
⅞" D. rivets spaced 3½ diams.
C.L. of Bkd.
Bottom Strake Horizontal
Fit Liner
Angle cut here and caulked
Fit Liner
C.L. of keelson
Stop here and caulk
All angles 3½ x 3½ x 25/32" Dbl. ⅞" D. rivets spaced 3½ diams.

Fig. 8.—Centerline Bulkhead Placed Off Center

The size of these buttresses will be taken from the rules of the registration societies. The weight of bulkhead plating and the size of the stiffeners will be in accordance to rule, and the only place that we cannot apply these rules will be in way of the double bottom. The centerline keelson in most vessels is watertight, and by putting extra rivets in the angle connections to the tank top and to the keel plate it can be made oiltight. The bulkhead will then be built on the strip of tank top plating remaining at the centerline.

It is advisable to place this bulkhead about 8 to 10 inches off center to keep the bulkhead angles clear of the keelson angles. This avoids cutting out rivets and insures tight work. (See Fig. 8.) Forward the offset will be measured on one side of the centerline and aft on the other so that the structural weights will balance. If the keelson is not tight it will be removed and the bulkhead will be built on the centerline from keel plate to expansion trunk.

(To be continued.)

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Davits and the New Requirements

Rules for Boat Davits in the Seaman's Act—How Various Types of Davits Meet These Requirements

BY HARRY W. BROADY *

Through the passing of new laws in this country and abroad, the davit question has become a very serious problem for shipowners to solve. The International Conference on Safety at Sea, in London, 1913, decided that mechanically operated davits should be required on board ships in the future. The time for the new requirements to go into effect is stated as immediately for all new ships, the keels of which are laid after December 31, 1914, and for existing ships not later than July 1, 1915.

The rules recommended by the London Conference are now enforced by all the big shipping nations. Last year the International rules were ratified by this country, but with such an amendment as to practically make the ratification of no value whatsoever.

The United States Board of Supervising Inspectors first specified mechanically operated davits on board ships in their rules of January, 1914. A very interesting feature in that ruling was that "The gear should make it possible for one man at each davit to swing the boat out clear of the side." Nothing was mentioned about list of the ship. This new rule was never enforced on account of pending legislation, and it is now superseded by the Seaman's Act.

The rules in the Seaman's Act in regard to davits are as follows:

"1. The davits shall be of such strength that the boats can be lowered with their full complement of persons and equipment, the vessel being assumed to have a list of fifteen degrees.

"2. The davits must be fitted with a gear of sufficient power to insure that the boat can be turned out against the maximum list under which the lowering of boats is possible on the vessel in question."

There is also a rule providing for the approval of other appliances in lieu of davits. These other appliances have, so far, not been worked out to a practical solution, as compared with davits, and do not come within the scope of this article, and are therefore not covered in any way.

The first of the two rules is very clear and simple. The engineering problem involved in this rule is very easily solved, both theoretically and practically, which will be shown later on in this article. On the other hand, the second rule is very uncertain. What is meant by maximum list under which lowering of boats is possible is rather hard to decide. It is practically left open to the decision of the inspecting official in every case.

Shortly after the approval of the Seaman's Act, the writer had an opportunity to discuss this rule with several of the more interested persons in shipbuilding circles. They almost uniformly expressed the belief that this rule could not be enforced. The requirements could be so constructed as to enforce the use of davits suitable for lowering the lifeboats to *clear* the side of the ship when the ship is listed 15 degrees. This would necessitate davits with tremendous outreach because in their opinion the boats must be made to clear the side of the ship even at the waterline.

If this should be true, it would be necessary to have an arm about 22 to 25 feet long with an outreach of 16 to 18 feet for a 24-foot by 7-foot lifeboat, if the tumble-home was 20 inches and the boat deck 30 feet above the waterline. This certainly cannot be the intention of the law makers and will never be enforced by the sensible men who have power to decide in this matter.

A very good and commonly used practice is to give the lifeboat a 12-inch clearance from the ship's side at the waterline, with the ship in an upright position and the davits fully swung out. The necessary outreach of the davits would then be equal to half the beam of the lifeboat, plus the tumble-home, plus 12 inches. If there is some larger obstruction like heavy fenders or guards on the ship's side in the way of the davits, the 12-inch clearance must be taken at that point.

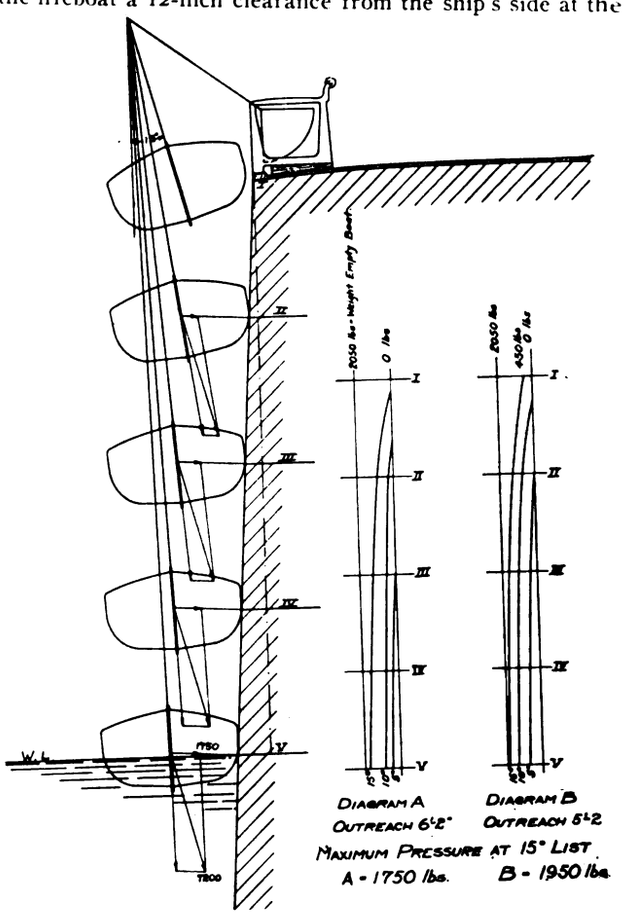

Fig. 1.—Diagram Showing Pressure of 24-Foot by 7-Foot Lifeboat Against Ship's Side. Weight of Lifeboat, 7,200 Pounds; Freeboard of Vessel, 30 Feet; Tumble-Home, 20 Inches

If the inspecting official should now insist on lowering the fully loaded boat at, say, 15 degrees list of the ship, what would happen? Take, for example, as shown on Fig. 1, a 24-foot by 7-foot lifeboat with a carrying capacity of 30 persons. The tumble-home is 20 inches and the davits have accordingly an outreach of 3 feet 6 inches + 20 inches + 12 inches = 6 feet 2 inches. The distance from the boat deck to the waterline is 30 feet. The weight

* Chief Engineer, Welin Marine Equipment Company, Long Island City, N. Y.

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of boat and equipment and number of persons allowed, taken at 165 pounds per person, is 7,200 pounds. The pressure that the boat exerts on the ship's side under these conditions is shown in the accompanying diagram A, Fig. 1, for a list of 5 degrees, 10 degrees and 15 degrees. In none of the inclinations does this pressure amount to as much as the weight of the empty boat, which is 2,050 pounds. The pressure is even less than this weight when no clearance is provided between the boat and the ship's side at the waterline, instead of the 12 inches assumed above, the outreach, therefore being only 3 feet 6 inches + 20 inches = 5 feet 2 inches, as shown in Diagram B, Fig. 1. Any lifeboat is strong enough to support its own weight in any position it may rest—side, bilge, keel or upside down—and the pressure is then greater than it would be in any of the above-mentioned cases. The boat can therefore not be harmed when sliding down against the ship's side, as long as the pressure between the boat and the ship's side does not exceed the weight of the empty boat and as long as the lowering is done with reasonable care.

If there are sharp edges and obstructions, such as fenders, etc., sticking out from the ship's side, rubbing strakes ought to be provided in the way of the davits for the boats to slide on. More than 15 degrees list will probably never be required, as it is almost a physical impossibility to stand on a deck listed more than 15 degrees to turn davits and boat out. If the boat only clears the ship's side at the deck at, say, a list of 15 degrees, and the davits are of the proper kind, the shipowner need not be afraid of being able to launch the boat and of fully meeting the requirements for moving the boat against a list into position ready for launching.

Fig. 2.—Installation of Round-Bar Davits with Turning Gear

The all-important question for a shipowner is, what kind of a davit will fully comply with the above rules? There are thousands of different types of davits and davit schemes, most of them patented. Very few of them have really been worked out practically and actually tried out on board ships. Almost all davits can be properly placed in some one of the different classes below:

Class A—Round-bar davits, working in a horizontal plane.

Class B—Round-bar davits with turning gear, working in the horizontal plane.

Class C—Trolley and track davits, working in the horizontal plane.

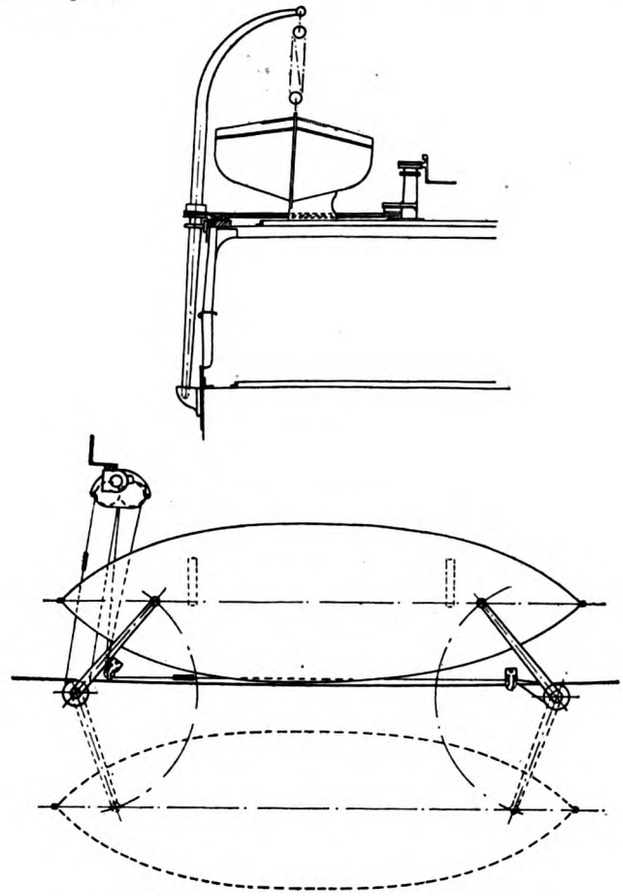

Fig. 3.—Welin Planet Gear for Turning Round-Bar Davits

Class D—Pivoted davits, working in the vertical plane, pivoted at one point.

Class E—Quadrant davits, working in the vertical plane, with moving fulcrum.

CLASS A DAVITS

Round-bar davits, Class A, could be made to comply with the first rule for the strength of davits, but never with the second rule for turning davits out against list. The boat must be pushed out, if it is going to be launched under a set of round-bar davits. This can perhaps be done when the ship is on an even keel, but as soon as there is a list, there will be a resistance against pushing the boat. This resistance will increase very rapidly with an increasing list and will make it impossible for the available men, even at a small list, to launch the boat. All the disadvantages of this class of davits are so well known that it is not necessary to go into further details about them, as these davits will not comply with the new law.

The discarding of this class of davits will naturally increase the safety on board ships, and this is what the law makers have been aiming at. Most of the ships nowadays are equipped with round-bar davits and will therefore have to be provided with mechanical davits. In such a case the shipowner will naturally try to find a turning gear that can be attached to his round-bar davits so that

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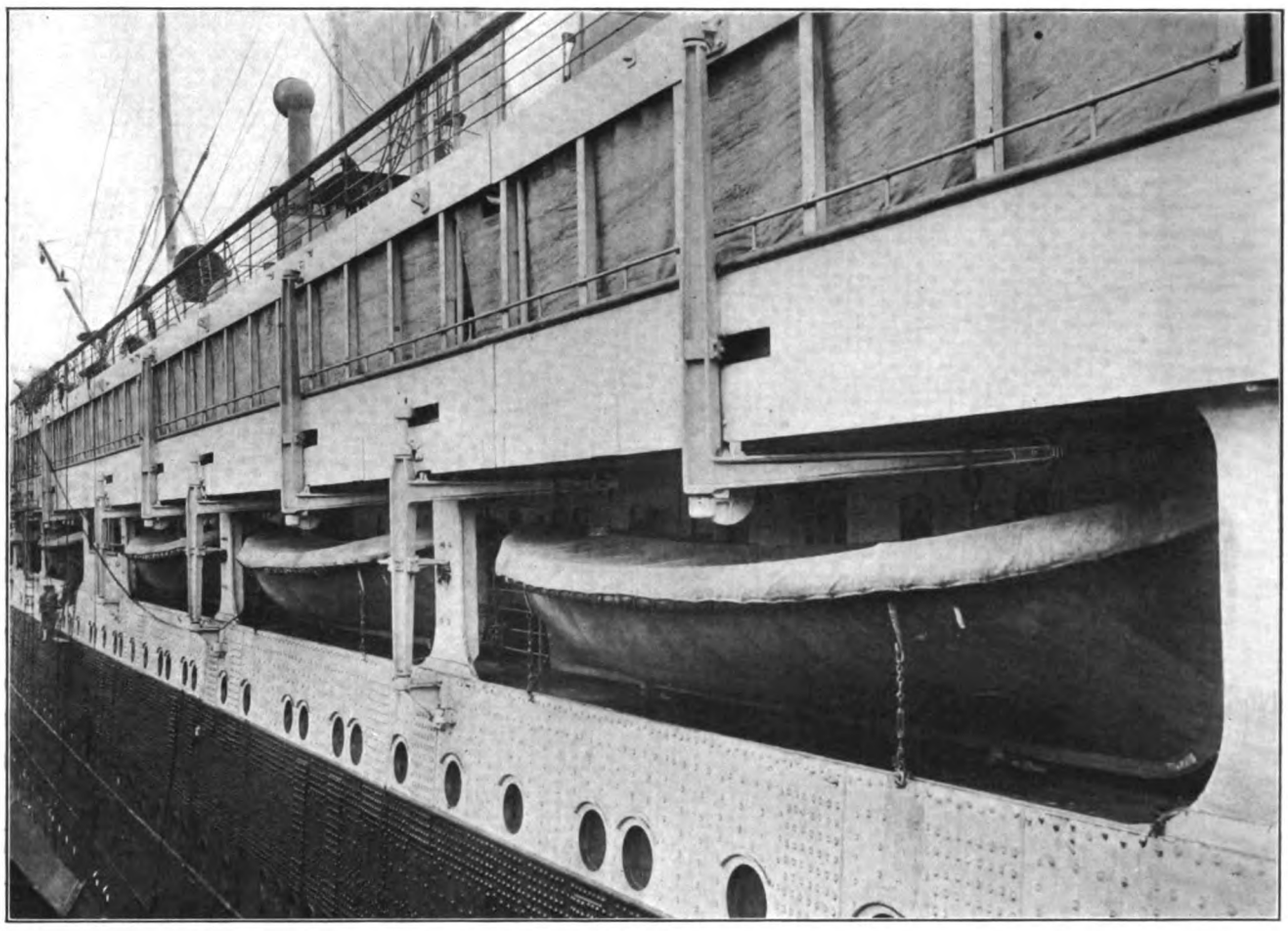

Fig. 4.—Davits for Handling Boats on Lower Decks. Installation on Hamburg-American Liner *Imperator*

they will comply with the new law. There are some very important things to be considered before such a change is made. These considerations are taken up under Class B, following.

CLASS B DAVITS

Round-bar davits with turning gear, Class B, are now installed on board several foreign ships and may be said to work with more or less success. They have been approved by the proper authorities as complying with the above rules, and an actual installation is shown in Fig. 2.

A davit of this kind consists of a round-bar arm swinging in bearing brackets and a gear arrangement secured rigidly to the ship. Owing to the necessity of large clearances in the bearings, to avoid sticking of the davits due to rust, and the deflection due to the suspended weight, the centerline of the vertical part of the arm will not be in the same position when swung outboard as when inboard. The deflection will, of course, increase with the weight and the list. It is therefore very clear to see that it will be impossible to get a good meshing in all positions between a gear on the vertical portion of the arm and the one in the part fixed to the deck. It is therefore impossible to use a worm gear drive directly on the davit arm. It is very desirable in order to control the turning properly to use a worm gear drive, as this can be made self-locking. To do this it is necessary to use spur gears between this drive and the davit arm. Even with this arrangement satisfactory results are very hard to obtain and cannot be recommended, as it is impossible to insure efficient working of the whole mechanism.

A very satisfactory solution is the Welin planet gear, patented in Great Britain. In this gear attachment all the troubles have been overcome by making the connection between the gear drive and the davit arms very flexible. The installation plan of such a gear is shown in Fig. 3. The arrangement for one set of davits consists of one deck standard containing the worm gear drive which through a pinion drives two drums. By means of a connecting link and partly toothed drums, the turning of the davits to swing out the boat will be exactly the same as the motion of the drums. The two drums are connected, one to each arm, by means of flexible wire rope. The grooved sheaves on the arms can be clamped on without the arms being taken out. The deflection of the arms and clearance in the bearing brackets will, in this case, not have the slightest effect on the efficiency of the gear. It will work just as well under all conditions. The planet gears have been installed on board several large ocean liners and work very satisfactorily.

The most important question for the shipowner to consider after he has found out that there are workable gear attachments to be had, is: Will it pay to install turning gear for the round-bar davits?

Take first, as an example, that it is a question of providing gear attachments for round-bar davits on an existing ship. First of all, it is necessary to find out if the old davits are strong enough to comply with the first rule for the strength of davits. In most cases they will not be strong enough and new davits, probably with greater outreach, will have to be installed. The old rule only required the davits to be strong enough to take the loaded

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boat with the ship on an even keel, and each person figured at 140 pounds. The new law requires the davits to be strong enough to take the loaded boat with the ship at 15 degrees list, and each person figured at 165 pounds. The difference of the stresses that the boats are subjected to in these two cases can easily be figured out, as will be shown later when the testing of davits is discussed. In most cases there is an increase of about 40 percent in the stresses.

If, now, it is also necessary to have a greater outreach, the stresses will be still further increased. This will necessitate the installation of new and heavier davits. The cost of the new round-bar davits plus the necessary gear attachment would be greater than for even the best mechanical davits. The weight of such an installation would also be considerably greater than other types of mechanical davits. This is further gone into under quadrant davits. It is therefore recommended that if new davits are necessary, all these should be of the best mechanical type. They would then be less expensive and also lighter and more efficient than the makeshift of round-bar davits and gear attachment.

The new law requires more lifeboats on most of the passenger ships. It will therefore be necessary to have more davits installed to take care of these extra lifeboats. Consideration should then be given to procuring the best type of davits and davits of the same make all over the ship. This will facilitate both the required boat drills and also the annual inspection.

A very interesting davit arrangement of this class is shown in Fig. 4, Welin Patent No. 1,094,617. This davit is specially designed for lower decks with one of the davit arms extending to the deck above and the other to the deck below, thus giving free room for the boat to swing out. It is provided with a turning gear.

FORMULA FOR ROUND-BAR DAVITS

The following formula will give the required diameter for round-bar davits, so as to fulfil the requirements of the first rule for the strength of davits:

$$D = \sqrt[3]{\frac{16\,W \times R \times (1+a)}{\pi \times K}} \qquad \ldots\ldots\ldots\ldots (1)$$

D = diameter of each davit arm in inches.
W = weight of boat with full complement of equipment and persons (figured at 165 pounds each), plus weight of tackle and blocks, all in pounds.
R = radius of overhang of davit arm in inches.
a = increase of W to take care of increase in stresses when ship is listed 15 degrees.
K = fiber stress allowed in pounds per square inch.

Example: 24-foot — 30-person lifeboat.

W = 7325, R = 95 inches, a = .22, K = 12,000.

$$D = \sqrt[3]{\frac{16 \times 7325 \times 95 \times (1+.22)}{\pi \times 12{,}000}}$$

$D = 7\frac{1}{8}$ inches.

The following average values substituted in above formula (1) will give a very simple and handy equation for calculating the diameter of the davit arms:

a = .25 and K = 12,000.

$D = .0812 \sqrt[3]{W \times R}$. $\ldots\ldots\ldots\ldots\ldots (2)$

If davits of structural steel are used, their dimensions must give the same strength as round-bar davits figured in accordance with above formula.

GRAVITY DAVITS

There are many davits working on the gravity principle. All of them could be placed in one of the classes, C, D and E. The characteristic feature of this type of davit is that the arms and the boat are swung out by means of the force of gravity due to their own weight when they are released. This can very easily be arranged for, even if the ship has a list, by designing the davits so that the vertical line through the center of gravity of the system of davit arms and boat is always to the outboard side of the pivoted point of the davit arms. The davits are easily recovered by means of a drum and rope or a block and tackle arrangement. They are generally very simple in their construction, as they do not require any gear or screw control; but they are also very unsafe, almost dangerous to handle, especially if the ship is rolling. The boat is not under satisfactory control, as a rolling ship can throw the center of gravity of the system inside the pivoted points of the arms, and the boat will

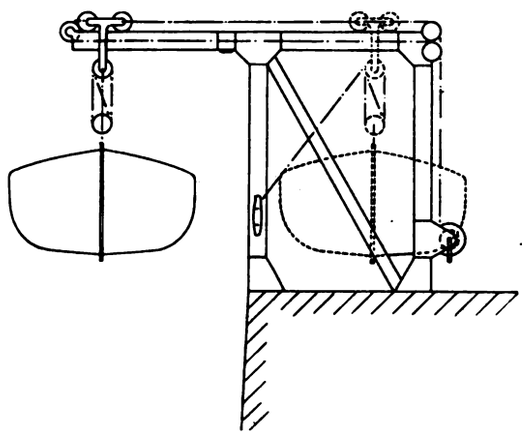

Fig. 5.—Trolley and Track Davit

then start to swing inboard again. It may also happen that the list is greater than the davits are designed for, thus making it impossible to launch the boat.

The wording of the rules seems to have excluded all davits of the gravity type, as it reads: "A gear fitted to davit." Therefore, as such davits, according to the wording, will not comply with the new law, they are not further considered in this article.

CLASS C DAVITS

Trolley and track davits, Class C, are very seldom used. Many patents have been issued for davits of this class, but very few have made further progress. The principle is theoretically the nearest to the ideal, as with such davits the figured power required to swing the boats out is less than for any other class of davits. All the friction to be overcome is rolling friction and no unnecessary lifting of the boat is done. A trolley and track davit arrangement is shown in Fig. 5.

The reason why this class of davits is not more universally used is: First, that they will necessarily be rather complicated at best. There must be folding or telescoping arms, reaching beyond the ship's side, when the boat is to be launched. These must be very securely locked and fastened in working position, so as to withstand the strain, if the ship is rolling or pitching. The folding arms must be held close to the ship's side, so as to be out of the way when not in use; they are sometimes made to slide in and out athwartship. The trolley arrangement necessary for taking the boat out must always be under control in all positions. This feature complicates the machinery considerably. The davit falls must be belayed in a suitable way, so that the boat is lifted as little as possible when swung out, thus minimizing the power required.

From the above statement it can be seen that not only

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is the machinery complicated, but the operations necessary to launch a boat are increased to three, viz.: First, to secure the outboard arms in position; second, to turn the boat out, and third, to lower the boat. With all other davits only two operations are needed—i. e., to swing out the davits and lower the boat. Operations of clearing and loading the boat are, of course, the same for all types of davits.

The second reason why this class of davits is not generally used is that they must always be rather heavy and are also clumsy looking. This is of importance because everyone knows that the word "ship-shape" stands for "neat and pleasing to the eye." The heaviness and clumsiness are especially objectionable when the davits are placed on the boat deck. The structure must be very rigid and substantial, as all the many working parts are high above the deck, and the whole outfit will therefore be very top-heavy. In all other davits the working parts are in the lower portion close to the deck. Trolley and track davits are naturally made of structural steel, but this does not improve them in any way, and it will add to the cost of upkeep, as compared with davits made of forgings or cast steel.

The third reason for not using the trolley or track davits is the cost. Owing to the great number of working parts and controls necessary, and also the heavy construction, the cost will naturally be considerably higher than for any other class of davits—even the best.

Only in one case can this class be of any advantage whatsoever, and that is for lower deck installation. No structure is there needed, the track is fastened under the upper deck and the appearance, under these circumstances, is not so noticeable; also they would be lighter and cheaper. However, the general opinion is that it is not good policy to place lifeboats on lower decks and it is very seldom done. Therefore this application of the trolley and track davits is of minor importance.

(*To be concluded.*)

Application of Electricity to Propulsion*

BY WILLIAM T. DONNELLY †

The electric power equipment of the *Dawn* (described in the May issue) has answered every anticipation and requirement, and the author is now prepared to take up the work of the second and principal object of its construction; that is, the application of electric power to the propulsion of one or more boats from the electric power boat. This is primarily a problem of a floating electric power station distributing power over a very limited area and working under the most advantageous conditions, that is the very lowest cost of power production, a very small cost for power distribution and operating under a very high load factor.

It has already been demonstrated that an electric motor will drive a screw propeller, and through that a boat, equally as well as it will do any other kind of work, and I might add that there is already some reason to believe that the action of an electric motor driving a screw propeller will show somewhat higher efficiency than is obtainable by a reciprocating engine. This is believed to be due to the fact that the turning moment of an electric motor is constant, while the turning moment from any reciprocating form of engine is variable, and it is believed that water as a resisting medium is very sensitive to the variation in turning moment. As a partial confirmation of this I would refer you to a very recent paper on "The Electrical Equipment of the Collier *Jupiter*," by Lieut. S. M. Robinson, read before the last meeting of the American Society of Naval Architects and Marine Engineers, in which a remarkable propeller efficiency is claimed.

* Concluded from the May issue. Extract from paper read before the Brooklyn Engineers' Club, January 14, 1915.

† Consulting Engineer, 17 Battery Place, New York.

Electrically Propelled Cargo Barge.

Referring to Fig. 12, there will be seen the type of cargo barge to which the writer hopes to apply electric propulsion at an early date. This barge is designed to carry about 200 tons of cargo and is of such dimensions as to be driven at approximately five miles an hour by 35 horsepower, the amount which will be available from the power boat *Dawn*.

Referring to the power plant on the barge (Fig. 13), it will be noticed that the application, while not new, is rather unusual. The motor is placed on the deck and drives downwards through a hollow rudder stem, transmitting the power to the propeller shaft mounted in the rudder by means of bevel pinion and gear. The particular object of this method of applying power is to increase the maneuvering power of the barge. By turning the rudder it will be possible to steer the barge without headway. This application of power is more particularly adapted to harbor and canal use, where only a comparatively small amount of power will be applied. It should be noted that the rudder in this case will always be balanced, as the thrust in any position is directly against the rudder post. There will, however, be a certain amount of unbalanced condition, due to the transmission of power. This will have to be taken care of by the steering gear. In the cross section of this barge (Fig. 14) is indicated the amount of space that a cargo of cement would occupy. From this it is very evident that in some instances a blunt form of cargo boat, giving great cargo capacity, is of no advantage, for it is very plain that in this case there is a very great excess of cargo space, and this feature opens up a very real question as to the design of hulls for special cargoes.

Flexible Electric Conductor

The only question which seems to be open regarding the possibility of applying electricity broadly by this method to marine transportation is the one of the flexible electric conductor, connecting the vessels together. In this connection it is, of course, well understood that in towing at the present time, with more that one boat in tow, all the power must be transmitted by a stress between the tow boat and the first vessel of the tow, then the full stress for the remaining part of the tow through the next connecting line, and so on to the end of the tow. In deep-sea towing, where the surge of the vessel due to wave action creates a very great stress, it is necessary to take care of the intermittent stress by an automatic steam windlass giving out and taking in the line.

With the transmission of electric energy over a flexible conductor, there will be no stress whatever upon the line, and in harbor, river and canal work it would seem that there would be little or no difficulty in keeping the boats grouped together or properly spaced by the control of the power, it being understood that the distribution of the current to the motors propelling the different boats can be adjusted not only at the power boat but also at the controller on each of the boats to which power is delivered. This controller will be ready at the hand of the man at the wheel, so that power and steering are controllable at the same time. Of course there is no restriction to having a supplementary line for limiting the distance, thus relieving the conductor of all possible stress. It is also possible to provide an automatic reel which will take care of the slack and give out line due to a maximum stress.

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For towing at sea, it is entirely possible to have a supplementary line or wire hawser which will automatically be kept at a definite tension, and, if found necessary, the conductor can be reeled on this or a separately controlled drum.

I do not regard the maintaining of a waterproof flexible conductor as a difficult problem, it being, of course, understood that with one insulated conductor at the center of the cable surrounded by the other conductor, it would be entirely practical to use the cable with the outer wires exposed.

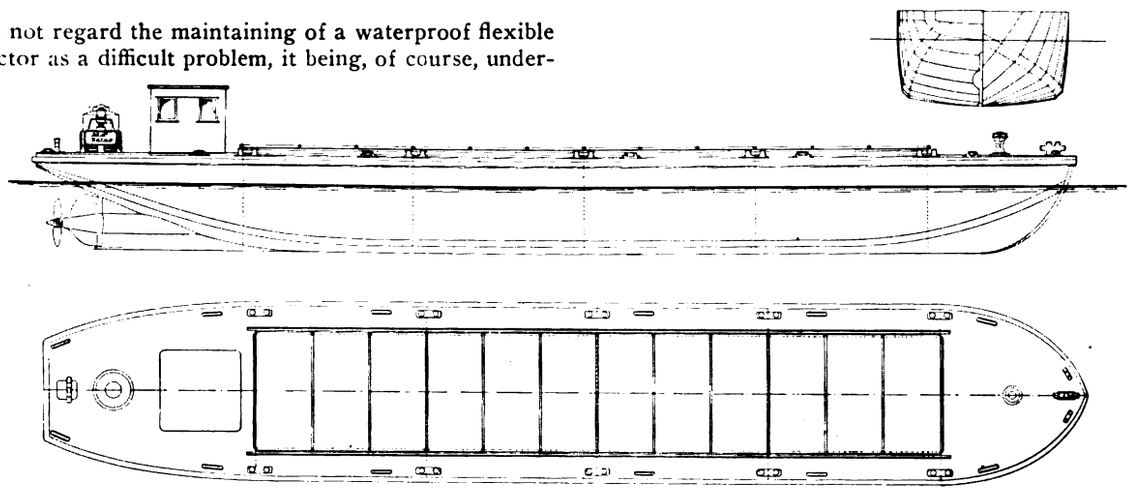

Fig. 12.—Design for Cargo Barge Equipped with Electric Drive

Regarding the cost of the electrical conductors, owing to the fact that towing is conducted at a slow rate of speed, the stress on the line for the transmission of power is comparatively high, and I have found that the probable cost of the electric conductor per unit of length will not be more than for the present towing lines for the same power transmission.

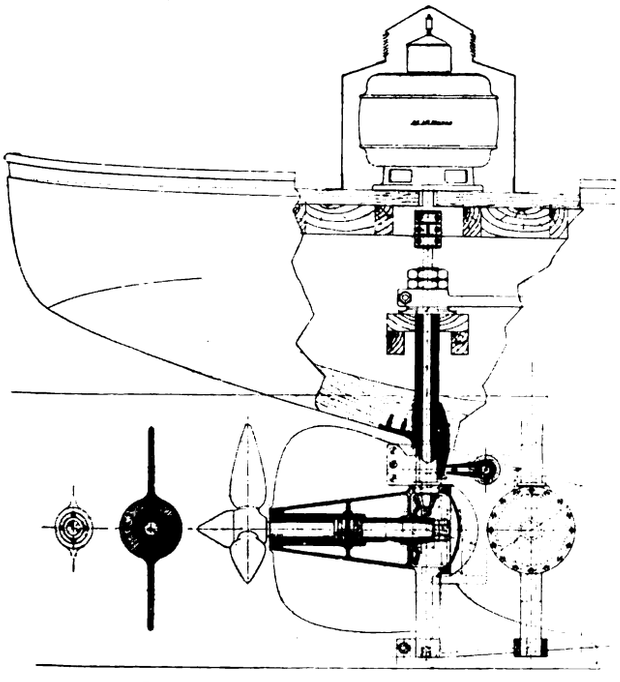

Fig. 13.—Power Plant of Cargo Barge

Granting the transfer of electricity from one vessel to another, there would seem to be left little or no difficulty to overcome: for it must be admitted that if an electric motor will drive one vessel, it will drive another, and the reliability of the electric motor has been so positively and clearly demonstrated in so many different applications that it is practically a foregone conclusion that it will uphold its reputation. It is not anticipated that this application of electricity will displace all other forms of propulsion, but it is firmly believed that it must have a very positive and broad application.

Broad Possibilities of Electric Propulsion

I wish now to point out in a general way a few of the broad possibilities resulting from the distribution of electricity on the water. It is perfectly plain from an engineering point of view that a very much better condition of things can be brought about if a vessel can be built for the generation of power only, and that a much better and safer passenger boat can be built if all questions of power generation and freight transportation can be eliminated. It is equally apparent that a vastly more suitable vessel can be provided for the transportation of freight of all kinds if the power plant can be eliminated with all its provisions as regards fuel, water, crew and stores.

An attempt was made in this direction when towing was adopted, but, as has been shown, the method of applying power by a tow boat is the very crudest possible form, whereas the application of electricity from one boat to another puts little or no restriction upon maneuvering power of either and provides for very great economy in power production. A cargo boat can be designed with little or no restrictions for any particular kind of merchandise, and provided with every facility for loading and unloading. The only requirement, so far as transportation is concerned, is that it shall have an electric motor driving suitable propelling means to operate it at a pre-determined rate of speed. In this relation it should be stated that a transportation rate of about eleven miles an hour has been determined as the economic rate of cargo transportation

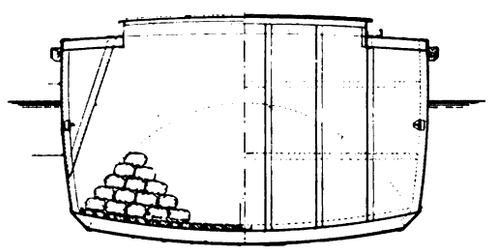

Fig. 14.—Midship Section of Cargo Barge

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over long distances, and it would appear that there should be no difficulty in maintaining this rate with a considerable fleet of cargo vessels.

It should be understood that in the ordinary method of towing it is practically impossible to determine the amount of power used or transmitted, but with the use of electricity it is practical to record the power both on the power boat and upon the vessel propelled, and to establish a price per kilowatt hour. It is of course evident that the amount of power will vary with weather and tide conditions, but this does not detract from the very great desirability of knowing exactly what power is used. This would very

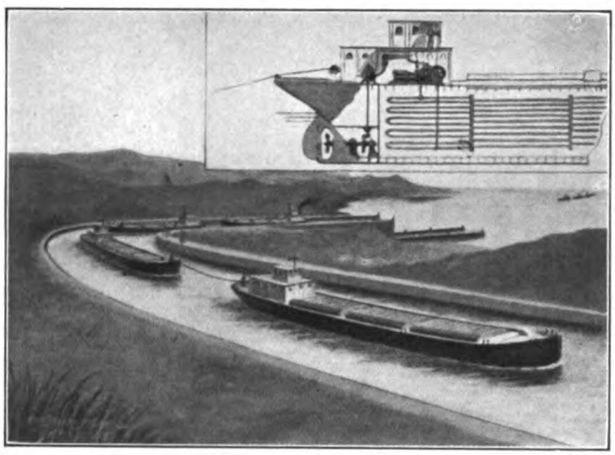

Fig. 15.—Electric Drive Applied to Canal Barges

greatly facilitate the development and sale of power afloat for the transportation of cargoes and other purposes.

Perhaps it is too early to discuss the application of this system to transatlantic passenger vessels, but it should be pointed out that with the elimination of the power plant, fuel and stores from a passenger boat, it would be entirely possible to make such a vessel absolutely safe against sinking, and that a power boat built only for that purpose could and has been made as an ice breaker of such strength and resistance that it could be driven without danger at full speed against ice.

Separate Power Boat for Sound and River Vessels

Relative to the propulsion of passenger boats in local waters, it is believed that this method offers very remarkable possibilities. Taking the steamboat lines with which we are most familiar, those running from New York to Albany and eastward on the Sound, these boats make a run of about ten hours and then lay up for the other fourteen. It is plain that a separate power boat operating one of these boats at the same rate of speed which they now make could deliver a night boat at Albany or Fall River and return with the day boat and have ample time between trips to coal up, it being understood that a power boat would go under the coal chute to receive coal, whereas a passenger boat has to have the coal brought to it and rehandled.

The elimination of the power plant upon a local passenger boat would make it entirely practical to make the boat fireproof; and for the summer season, when these boats are mostly used, it would eliminate all heat and other annoyance due to noise and cinders.

Referring to Fig. 15, there will be seen another adaptation in which a power boat is shown conducting a line of canal barges fitted up for cold storage, it being understood that the power boat would not only furnish the propelling power but also the power necessary to do the refrigerating of the cargo in transit. At the present time vast quantities of perishable goods are handled by the railroads by means of refrigerating cars, the refrigeration being carried on by icing. It is of course apparent that this transportation could be carried on with vastly greater economy by water.

Other Uses for Floating Electric Power Station

This opens up the possibility of the use of electricity generated on board vessels for other purposes than propulsion, and it is at once apparent that there is no restriction whatever as regards the use of electric power generated afloat. It can be applied to another floating vessel for any possible purpose, such as handling cargo, refrigerating, lighting, heating, electric welding, cooking, etc. It can also be transmitted ashore and used for any conceivable purpose when the power boat is not engaged in the transportation business. This function is of very great importance when northern waters, which are closed for a considerable period of the year, are considered, as the closed season is coincident with the longer nights and the very much greater demand for electricity for lighting. It is apparent that an electric power vessel could be laid up alongside of a coal supply and deliver electricity at a unit cost much less than from a power station.

A further possible use for an electric power vessel when not actually engaged in transportation is for the making of artificial ice. This, of course, would apply more particularly to warmer climates where ice is now made arti-

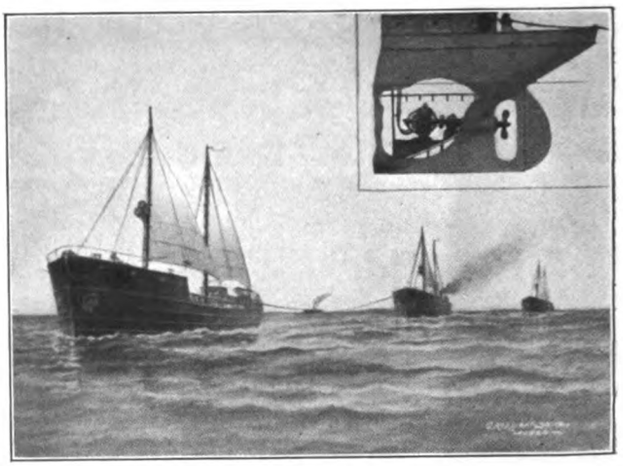

Fig. 16.—Sea-Going Electric Tow

ficially. It is, of course, well understood by engineers that the main essential in refrigeration is the cooling water, which must be provided to carry away heat from the compressed gas used in refrigeration. A vessel floats in this medium; and from the fact that it can go to the fuel supply, it is possible to furnish power for making ice from a floating electric power plant at a less price than from a central station, and it would appear certain that, in case of this development, the making and distribution of artificial ice will be very much increased.

LECTURE ON SUBMARINES.—In an interesting lecture delivered in Brooklyn, N. Y., on May 13 before the New York Branch of the American Society of Marine Draftsmen, Lieut. C. W. Nimitz, U. S. N., described in detail the construction and operation of the United States submarines. It was pointed out that while the submarine is an ideal defensive weapon, especially for breaking up a blockade or for preventing landings, nevertheless it should not be considered as a substitute for battleships in the naval strength of a nation.

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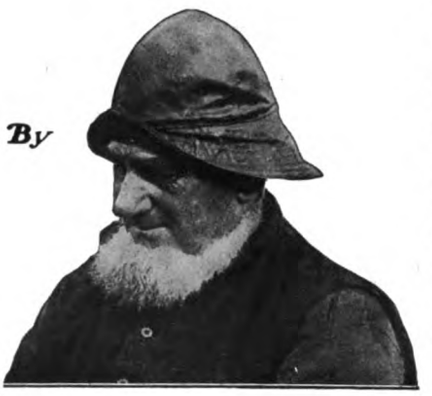
Economy Talks By "Old Scotch"



How to Avoid Big Repair Bills

All the methods of saving money for the owners of a ship are not confined to the operation of the machinery, by any means. No matter how careful we may be in watching the corners on coal, oil and other supplies, all that we may save in that direction can soon be wiped out in one week's repairs, if we do not watch things carefully when the ship gets into the hands of the shop people for the routine repairs.

We can prevent the necessity for a great many repairs by following the old adage of "A stitch in time saves nine," as that is very applicable to the proper care of marine machinery. If we find that some "husky" has exerted too much strength on some particular stud and twisted it off, the proper thing to do is to get busy at the first opportunity and put in a new stud. If you can locate the fellow who did the "twisting off," make him put in the new stud, as that will be a good object lesson for him to reserve his strength in the future for something strong enough to stand it. If you hear a faint sizzle in any of the boiler seams, get right after it with a calking tool and hush it up, or otherwise it will gradually develop into a serious leak, which will soon require the services of a high-priced boiler maker. If a valve starts to leak, treat it at once to a few twists of powdered glass and save a badly scoured seat later on. When a joint starts to weep, heal its sorrow at the first chance you get, either by setting up on the bolts or putting in a new gasket.

It is the attention to these small details in every-day running which prevents many of the big items of repairs at the end of the season. I know of one big steamship line which has an invariable rule that everything that is broken or missing, even to the smallest screw or nail in the ship, must be reported to the superintendent as soon as each ship gets into port. Then they go right after every little detail and fix it up. The result is that the repair bills on those vessels are kept at a minimum.

However, things will wear and accidents will happen in spite of all precautions, and occasionally our ships have to go to the shops. By using good judgment and plenty of attention the bills can be kept down, if we really want to practice economy. We don't all have to be experts to reduce costs, as just a few grains of common sense go a long ways sometimes.

For instance, I was chief of a ship not long ago which went into the dock for repairs. Of course we overhauled the sea valves, took off the strainers, etc. Much to my surprise I found a hole as big as a man's first eaten into the water side of the cast-steel sea connection to the main injection valve, up near the flange where it could not be patched. Strange to say, it had not quite gone through the casting, but there was only about a quarter-inch thickness of good metal left at the bottom of the pit.

Here was a pretty mess of fish, with dock charges of $150 (31/5/0) a day staring us in the face. An estimate was given us to furnish a new iron casting for the stool at a total cost of $450 (93/15/0), and a delay of four days in the dock. The ship was booked to sail in two days with a valuable charter, and things were popping sure enough. I indulged in a large amount of cussing; but that didn't do any good, so a happy thought came to me. I had heard a good deal of talk about this newfangled idea of oxy-acetylene welding, and it occurred to me that we might have a piece of soft iron welded into the pit.

I put the idea up to the foreman of the yard and he opined that he could make a good job of it. "Go to it!" said I, and the result was that a piece of wrought iron was welded into that hole as slick as anything you ever saw done. The total charge was $15 (3/2/6), and the ship came out of the dock on time. The owners gave me a box of Havanas for the idea, but my principal reward was in the knowledge that I had used my head for something else than a hat form.

Since that time I have saved a number of expensive repair jobs by using this useful apparatus. In my early days I would have scouted the idea that you could weld castings, and do all kinds of funny stunts such as can now readily be performed with this gas-blowing business.

In making out requisitions or specifications for repairs, you first should know exactly what you want to have done. This thing of saying, "Oh, I want this pump given a general overhauling," is what costs money. Find out exactly wherein the repairs are needed; if the water cylinder needs re-bushing, if the valve stems need renewing, or whatever is needed, make out a specific list and state clearly just what is needed, and get estimates on necessary work only. If you put down general requirements, the machine shop people will naturally want to protect themselves from any whims which the inspector for the job may develop after the contract for the job is given out, and you can bet they will provide against any losses on that account.

There are so many things to guard against, in order to save money on repairs, that I believe I will touch up this subject again later on.

Yours for economy,

Old Scotch

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT*

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out, and the horsepower calculated, provided complete data are sent with the cards.

Weight of Brass Sleeve on Tail Shaft

Q.—The following question was asked on a recent examination: What is the weight of the brass sleeve on a tail shaft? Diameter shaft, 11 inches; thickness of sleeve, ¾ inch; length of sleeve, 5 feet. Will you please show how it should be worked out? S. O. H.

A.—Naval brass weighs 530 pounds per cubic foot. The volume of the sleeve is the difference in volume between two cylinders 5 feet long, one having a diameter equal to 12½ inches (to the outside of the sleeve) and the other having a diameter of 11 inches (to the inside of the sleeve).

$$\frac{\pi D^2}{4} \times L = \text{volume to outside of casing.}$$

$$\frac{\pi d^2}{4} \times L = \text{volume to inside of casing.}$$

Therefore, net volume =

$$\frac{\pi L}{4}(D^2 - d^2) = \frac{3.14 \times 5}{4}\left\{\left(\frac{12.5}{12}\right)^2 - \left(\frac{11}{12}\right)^2\right\}$$

$$= 3.93\left(\frac{35.3}{144}\right) = .964 \text{ cubic feet.}$$

$$\text{Weight} = .964 \times 530 = 511 \text{ pounds.}$$

Size of Safety Valve

Q.—What size safety valve would be required for a single-ended cylindrical Scotch boiler of 16 feet diameter by 11 feet 6 inches length; grate surface, 68.6 square feet; heating surface, 2994 square feet; working pressure, 180 pounds gage? H. M. T.

A.—The rules of the American Board of Steamboat Inspection require safety valves to have an area in accordance with the following formula:

$$a = .2074 \frac{W}{P}.$$

where a = the area of safety valve in square inches per square foot of grate surface.

W = pounds of water evaporated per square foot of grate surface per hour.

P = absolute pressure, pounds per square inch.

For the boiler mentioned reasonable values of water evaporated per pound of coal and coal per square foot of grate surface per hour would be 9½ and 25, so that $W = 9½ \times 25 = 238$, and the total area required for the safety valve would be

$$68.6 \times .2074 \times \frac{238}{195} = 17.38 \text{ square inches.}$$

Probably two valves would be used, each of about 8.7 square inches area. In general it may be said that safety valves should be capable of discharging all the steam that can be generated in a boiler without allowing the pressure to become excessive (say not more than 10 percent above normal), so that their size depends upon both coal burned and evaporation per pound of coal. The American rules governing this are much more logical than the European ones which follow:

(British Board of Trade for natural draft):

$$\text{area} = \frac{37.5 \times \text{grate area in square feet}}{\text{absolute pressure}}.$$

(Lloyds):

area = ½ square inch per square foot of grate area.

(French Government):

$$\text{Diameter of 1 valve} = \sqrt{\frac{\text{total heating surface (square feet)}}{\text{pressure} + 9}} \quad \text{(English units)}$$

(German Government):

Clear area = x millimeters per square meter of heating surface. x varies from 131 at 75 pounds to 51 at 240 pounds.

Diameter and Length of Turbine Rotors

Q.—What is the length and diameter of the rotor of a Curtis steam turbine of 1,000 horsepower capacity at 2,000 revolutions per minute, with a steam pressure of 250 pounds per square inch? Also, what is the diameter and length of the rotor of a Parsons turbine of the same horsepower and revolutions? E. M.

A.—A turbine of this power, operating at revolutions as high as 2,000 per minute, is unsuitable for marine propulsion unless the speed of the propeller is reduced by gearing. The nearest approach to it were the turbines of the *Turbinia*, which operated at about 700 revolutions per minute and developed some over 1,000 horsepower per shaft. These turbines were of the Parsons type with the high-pressure rotor 40 inches in diameter, low-pressure rotor 48 inches in diameter, the turbines having diameters over casings of 48 inches and 56 inches respectively and lengths of 8 feet 6 inches and 11 feet. A recent geared turbine installation, also of the Parsons type, had the high-pressure rotor approximately 36 inches diameter and the low-pressure rotor approximately 48 inches diameter, each rotor having a length of 10 feet. The turbines over casings were 15 feet long, and including gears about 20 feet long.

A Curtis turbine recently installed in a hgh-speed yacht had the following dimensions: 29 stages, 30-inch rotor, 300 pound boiler pressure, 1,700 brake horsepower and 1,350 revolutions per minute. Diameter over casing, 3 feet 2 inches; length over casing, 11 feet 10 inches (including thrust block and reversing turbine) and about 2 feet less excluding the reversing turbine. The weight equals 16,000 pounds.

Comparative Economy of Discharging Steam from Evaporator into Hot Well, Condenser or Low Pressure Receiver

Q.—Will you please tell me whether it is more economical to discharge the steam from an evaporator used for making up feed water into the hot well or into the low-pressure receiver of a triple expansion engine; and if it is not too much work, the method of making the calculations? S. O.

A.—It is more economical to discharge directly into the hot well, because then the heat of vaporization is retained in the ship's plant instead of being thrown overboard in the discharge from the circulating pump. The following

* Associate Professor of Naval Architecture, Massachusetts Institute of Technology, Boston, Mass.

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calculation will be interesting as illustrative of this point.

If we assume the feed temperature to be 200 degrees F. and the evaporator is arranged to discharge normally at atmospheric pressure, the net cost in B. T. U.'s of 1 pound fresh feed water at 200 degrees when delivered, first, directly to the condenser, second, to the low-pressure receiver, and third, into the hot well and there condensed, follows:

1. It will require, in order to raise 1 pound of water into dry steam at 15 pounds absolute

NOTE: $\left\{\begin{matrix} x = \text{quality.} \\ r = \text{heat of vaporization.} \\ q = \text{heat of liquid.} \end{matrix}\right\}$ values from Peabody's steam tables.

$$x\,r + q = 969.1 + 181.3 = 1150.4 \text{ B. T. U.}$$

less the heat of the liquid of sea water (which we may assume to be at 53 degrees F., or $q = 21.1$).

$$1150.4 - 21.1 = 1129.3 \text{ B. T. U.}$$

This is the total heat put into 1 pound of water to raise it from 53 degrees F. into dry steam at 15 pounds pressure. Assume that the temperature of the hot well is 110 degrees and 15 pounds absolute, then leading the steam directly into it, it would at once condense and give up heat equal to 1,150.4 — q (at 110 degrees) = 1,150.4 — 78 = 1,072.4. So that the actual net cost in B. T. U. has been

$$1129.3 - 1072.4 = \mathbf{56.9.}$$

2. Now if the steam is led to the condenser at 2 pounds pressure, it gives up r = 1,021.9 B. T. U. in condensing into water, and this is carried outboard and lost, and all that is conserved is

$$1150.4 - 1021.9 = 128.5;$$

therefore, the net cost of 1 pound of make-up feed water at the air pump is

$$1129.3 - 128.5 = \mathbf{1000.8.}$$

3. If we lead the steam to the low-pressure receiver, it does some work in the low-pressure cylinder which should be credited to it. If we assume 15 pounds steam per horsepower per hour, and 1.2 pounds coal per horsepower per hour, it obviously requires .08 pound of coal to generate 1 pound of steam. One pound of coal may have 14,000 B. T. U., and allowing a boiler efficiency of 60 percent, 1 pound of coal puts 8,400 B. T. U. into the water, so that .08 pound has an approximate value of 672 B. T. U., or, stated slightly differently, a pound of steam at the engine throttle has cost net about 672 B. T. U.'s. In a triple expansion engine, one might consider two-thirds of it has been utilized, leaving one-third, or 224 B. T. U.'s, available at the entrance to the low-pressure receiver. This, then, is what should be credited for each pound of steam injected into this place, so that the actual net cost in B. T. U.'s of 1 pound of feed water, if the evaporator discharges into low-pressure receiver, is the same as that when discharging into the condenser minus this credit, or

$$1000 - 224 = \mathbf{776 \text{ B. T. U.}}$$

A more accurate calculation could be made if we could predict the quality of the steam in the main engine at the low-pressure receiver. If, for example, the moisture were 10 percent and the pressure 15 pounds, the total heat would be

$$Xr + q = .90 \times 969 + 181 = 1053.$$

and the heat which has been put into the steam by the boilers is

$$1053 - q \text{ (of feed at } 200^\circ) = 1053 - 168 = \mathbf{885.}$$

To this should be added the heat put in by the feed water heater to raise the water from 110 degrees to 200 degrees (90 B. T. U.'s) and the heat of the liquid of the condensate (78) subtracted in order to get the cost in B. T. U's

$$885 + 90 - 78 = 897.$$

There has been work done in the low-pressure cylinder, however, and the heat used for this should be subtracted in order to get the net cost. If we assume adiabatic expansion from 15 pounds to 2 pounds at entropy 1.61, the heat transformed into work is

$$(x\,r + q \text{ at 15 pounds}) - (x\,r + q \text{ at 2 pounds}) = 1053 - 934 = 119 \text{ B. T. U.}$$

Crediting this to the cost gives as the net cost

$$897 - 119 = \mathbf{778 \text{ B. T. U.}}$$

whch is approximately what was found by the other method of calculation.

To sum up, then, for the case in hand, it would cost to produce 1 pound of feed water by the three methods stated

(1) 57 B. T. U., if discharged into hot well.

(2) 1,000 B. T. U., if discharged into condenser.

(3) 777 B. T. U., if discharged into low-pressure receiver.

In other words it costs approximately 13½ times as much to discharge into the low-pressure receiver and 17½ times as much to discharge directly into the condenser as to discharge directly into the hot well. Where evaporators discharge directly into the condenser they operate against a less pressure than that assumed above. This, however, does not result in any material gain in economy; for while the total heat is less, the amount conserved is also less, as the heat abstracted by the condensing water remains the same.

Trials of Hydraulic Dredge

Q.—Will you kindly outline in the Department of Questions and Answers for Marine Engineers the method of procedure, and give a list of data to be ascertained in conducting a test of a new hydraulic dredge? The purpose of this test is: (1) first, to ascertain the fuel and water consumption and the general efficiency, and (2), to determine whether the equipment is properly proportioned and to discover any weak points in the design. The main equipment of the dredge is as follows: 20-inch centrifugal pump, direct-connected to 750 horsepower triple-expansion engine, with surface condenser; 12-inch by 12-inch double cylinder simple cutter engine; 10-inch by 10-inch double-cylinder throttle-reversing engine; three 12-foot by 12-foot Scotch boilers; seven auxiliary pumps; two dynamo sets; one filtering hot well and one filter for make-up water, etc. B. F. W.

A.—It is customary to require for dredges of this sort two trials, usually classified as (1) preliminary trials, (2) final trials. The preliminary trials are intended to fully test the machinery, and the pumps and pumping engines are given a continuous full-speed run of eight hours' duration with the cutter head submerged. They are operated against a head equivalent to about a mile of pipe line of the diameter of the dredge, and it is common to specify a minimum pressure at the discharge of the pump (for a case of this sort about 47 pounds). All auxiliary machinery is operated continuously for eight hours at the same time and any defects developing during these tests are made good by the contractor. Expenses of tests are borne by the contractor.

For the final trial it is customary to require that the dredge shall be given a trial of thirty working days of twenty-four hours each and all parts of the machinery which give out or show undue wear during this trial are required to be replaced at the expense of the contractor. The final trial is essentially an operating test and it is rare that the obtaining of data is attempted. In the preliminary tests, however, the plant should be made to provide a complete boiler and efficiency test and the following data should be determined:

1. Indicator cards all main engines at twenty-minute intervals. 2. Gages. 3. Weight of water fed to boilers. 4. Weight of coal fired. 5. CO_2 determination. 6. Quality of steam by calorimeter. 7. Revolutions per minute. 8. Steam consumption of auxiliaries. 9. Pressure and velocity in pipe line. 10. Calorific value of coal by sample.

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

How Compressed Air Saved the Steamship Floriston

Shortly after the beginning of the war in Europe, the steamship *Floriston* sailed from Quebec under rush orders bound for England with a cargo of hulled grain. Officially, the ship has a gross tonnage of 3,429 tons and a net tonnage of 2,236 tons. However, owing to the exigencies of the hour, she was actually loaded with 4,000 tons of wheat, which put her down considerably deeper than her Plimsoll mark.

Just before clearing the Straits of Belle Isle on a dark night the ship hit an iceberg squarely bow-on when running at a speed of about 10 knots. She was so badly injured that her skipper ran her ashore upon the nearest point of the coast of Newfoundland. There for several days she pounded upon the rocky bottom and materially aggravated the damage forward. A small steamer, the *Wren*, came to the rescue of the *Floriston* and managed to pull her off and to tow her into Port Saunders—the nearest haven. The *Floriston* came to anchor in 13 fathoms of water, and at the time was drawing 31 feet forward and 22 feet 4 inches aft. After practically abandoning all hope of saving her, recourse was had to compressed air under the supervision of Mr. W. W. Wotherspoon of New York city, and the damaged craft was safely run under her own power some hundreds of miles to Quebec.

It was not until the *Floriston* reached Port Saunders that it was possible to examine her injuries. After the divers had made two surveys, it was found that the vessel's bow had been very badly crumpled up. The accompanying illustrations clearly indicate the extent. The upper and the lower forepeak were flooded, and so, too, were cargo space No. 1 and Nos. 1 and 2 ballast tanks, while ballast tank No. 3 was leaking, but could be kept under control by the ship's pumps.

The Canadian Salvage Company and the Quebec Wrecking Company took the ship in hand and started at once to make her ready for the application of compressed air—first removing about 800 tons of grain from the for-

Fig. 2.—Steamer *Floriston*

ward hold, where fermentation had started and the gasing was very noticeable. Immediately after the installation of the necessary air compressors, ballast tanks Nos. 1 and 2, and so much of the lower forepeak above the ruptured skin were placed under pressure and "blown," together with the upper forepeak, and in this way the vessel's bow was raised 4 feet, bringing her to the 26-foot waterline.

In making the air connections, the existing air vents were used in the drained compartments for conduits, while certain other air vents were sealed. In this manner complete control of the various spaces was secured from a single operating station on the main deck. In accordance

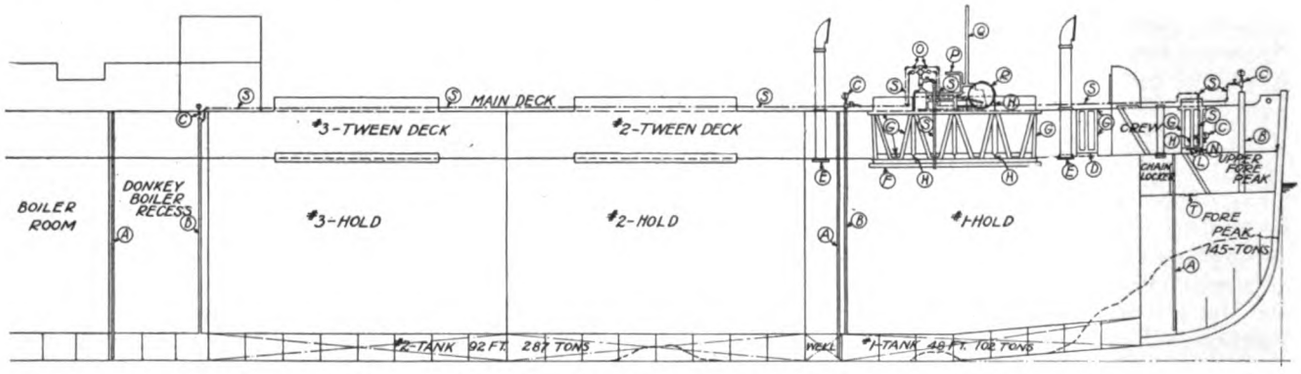

Fig. 1.—*A*, Sounding Pipes Closed to Compartments Placed Under Pressure. *B*, Air Escapes Used for Connecting Pressure Sets to Compartments Placed Under Pressure. *C*, Pressure Sets. *D*, Closing Cover for Trimming Hatch. *E*, Closing Covers for Ventilators. *F*, Closing Hatch for No. 1 Hold. *G*, Shoring and Bracing for Hatch Covers. *H*, Strong-backs Bolted to Ship's Structure. *J*, Closing Covers for Hawse Pipes. *K*, Closing Hatch for Air-lock. *L*, Underhung Escape Hatch for Air-lock. *N*, Blow-off. *O*, Control Valves for Air Supply to Compartments. *P*, Steam Supply to Compressor. *Q*, Exhaust from Compressor. *R*, Air Compressor. *S*, Air Supply Pipes to Compartments *T*, Manhole Access Forepeak

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Fig. 3.—Damage to Bow of Steamer *Floriston* after Collision with Iceberg

with the Wotherspoon system the flanking compartments or neighboring spaces were also put under pressure, in order to reduce the stresses upon the divisional bulkheads and the overlying decks. The large hatch leading into cargo space No. 1 was sealed by an airtight cover composed of two layers of planking with intervening sheets of tar paper. The hatch leading into the upper forepeak was similarly sealed, with the addition of an air-lock attachment by which admission into the forepeak could be secured when that space and the compartment below were under pressure. In order to support the deck immediately above the forepeak and the cargo space, shores were placed between it and the main deck just above. This was a very necessary provision, because the *Floriston* was inclined to "hump" as she forged ahead on her long trip to Quebec, and the intermittent stresses would probably have proved fatal but for the stiffening secured by binding the two decks together in this fashion.

The entire work of preparing the *Floriston* for her run from Port Saunders to Quebec was finished in the quick time of six days, thanks to the experience previously gained in handling some other vessels in the same manner, although not so far away from bases of repair. The nature of the steamer's cargo demanded rapid action, and compressed air was the very best medium with which to battle with the gases given off by fermentation while furnishing the needful support to the confining bulkheads and deck plating. The salvers were obliged to watch this subtle foe at every stage of the homeward journey and to adjust the air pressure in the surrounding compartments accordingly.

The accompanying diagram shows the manner in which the salvage installation was made, and it is doubtful that the vessel could have been saved by any other method, considering the cargo aboard and her remoteness from any place for repairs. It was quite out of the question to use cement on the job, and compressed air was logically the only rational solution under the circumstances. The gravity of the *Floriston's* wounds are quite manifest, but because her stem and forefoot were turned so far back and upward, the first diver reported rather moderate injuries—assuming merely the rupture of the bottom plating and judging the upturned stem to be the lower edge of the break. This long trip to a repair port emphasizes the potential advantages of a permanent compressed air self-salving installation aboard large ocean-going vessels. The initial cost is moderate, and ships so equipped would unquestionably be able to obtain better insurance rates and shippers and owners feel just that much more secure.

New York. ROBERT G. SKERRETT.

Some Hazardous Experiences at Sea

While ill luck may pursue many an engineer afloat and continue very persistently, it nevertheless cannot be said that he does not benefit by such experience, especially where mishaps to machinery are concerned, as the faculty for repairing under difficulties is generally sharpened under stress and contributes towards those valuable attributes—coolness and presence of mind.

My first experience on a breakdown in the capacity of third engineeer was in a new mail steamer making a maiden trip from Sunderland to Australia for the..... line of Melbourne. Our craft was, to use a technical expression, very "tender," and having somewhat fine lines, that quality was accentuated to such an extent

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that she took a list as soon as she entered the water, and only by frequent manipulation of her water ballast could she be brought upright and then only probably to take a slight heel over to the other side, so that it became talked around that she would not get to her destination.

Our troubles began on the trial trip, when the condenser tubes leaked to such an extent that the trial had to be brought to a hurried conclusion in order to make good, after which we made another final trial, and this time headed south for Dover, where the builders' engine-crowd quit. We were now four engineers, or two short of the full complement of six. Shortly after leaving Dover the condenser gave out again and we had to make for Southampton water, where on getting up gratings and taking off heavy doors, etc., it was found that several tubes had started, due primarily to the direction in which the exhaust steam entered the condenser and partly to the tubes being inefficiently packed.

After a four hours' sprint we made the job comparatively tight, and headed for the long walk. "Priming" now became the bugbear, and though much in evidence at the outset, became now more pronounced, as we had only two of the four boilers under steam. This, to some extent, caused these two to be forced to a greater extent than they otherwise would have been, and the matter of priming, incident particularly to new boilers, became considerably aggravated. Our chief's nerves evidently sustained a shock at the outset, for apart from insisting on six-hour watches, in order to "take it out of us," he frequently encouraged us by pacing the engine-room platform, waving his hands and clawing them through his hair with magnificent gesture and flourish. The fact that he was a big man and stood 6 feet 2 inches in his socks, gave the affair a certain pathos as affecting in character as it was obvious in effect.

Well, we arrived at Freemantle and congratulated ourselves for small mercies. But shortly after getting under weigh with four boilers going with the idea of making some sort of a record for the concluding part of the trip, priming set up more furiously than ever, and slob as we would with the grease brushes we could not keep the high-pressure rod from heating up even with a plentiful application of white lead, black oil and tallow. We were compelled to stop and repack the gland, after which we again proceeded, but only for a short distance, as the trouble was still there. On feeling the rod I detected grit and an inky fluid coming from the gland. It was now patent that the boiler water could not be in a state of transparency; furthermore, the feed water disclosed a very black state of affairs, inasmuch as bilge water was supplementing the feed. Though we did not know it at the time, the rod had seized on the neck ring and formed on it a sort of shallow inverted U on account of the grit which was passing through, due to the priming of the boiler water.

It appears that the chief ordered the fourth engineer to pump out the exhaust tank by means of a Weir's pump through a direct connection leading to the condenser. The valve connecting the tank and condenser was left open inadvertently. As an overflow pipe led from exhaust tank to the bilge and down into the bilge water; the result was that when the main engines were started and a vacuum created, said bilge water was drawn into the tank and condenser with the result mentioned. Consequently our high-pressure engine was fluxed with grit and dirt and was disabled. We had a four-cylinder set of triple-expansion engines with two low-pressure engines. After 17 hours' strenuous work we converted her into a compound by taking out the high-pressure piston valve and disconnecting and swinging up the rest of the engine and securely lashing the same.

When we had finished, our poor second (an extra chief) threw himself on to a heap of ashes in the boiler room through sheer exhaustion, while dancing progressed among the 200 guests or passengers (which were taken on at the Cape) and who in fact had little idea of the tension below. During the process of converting we never left the engine room and sandwiches were brought to us.

After leaving Melbourne, where the engines underwent a thorough overhaul, we made some fast trips to Queensland and way ports, and on one occasion had the satisfaction of beating the record of a competitive liner, on which we cut out a big brass sheet cock and fixed it up on the funnel as an indication to all whom it might concern that we were "Cock of the Walk." A reception and banquet which followed, with dancing which continued well into the "wee sma' hoors ayant the twal," soon enabled us to forget our past troubles.

An experience subsequent to this was in a small salvage tug. I was engaged to go out as chief to Havana and then to be transferred in a similar capacity to a Hamburg-American cargo boat which the salvage company had acquired in payment of a salvage claim. The steamer had caught fire during a conflagration on the wharves of that port and the company had sunk the craft in the harbor before the fire had done much damage.

Both the captain and myself had invested $975 (£200) in the company and my return was to be $122 (£25) per month with a percentage of profits, so it looked to be all right. My trouble began as soon as we left London, which was during severe October gales, when some 200 craft were taking shelter in the Downs. It took us a week to get around from London to Plymouth, and at Falmouth we had to negotiate for and carry out repairs incident to the severe buffeting we had sustained.

We arrived eventually at the Azores Islands, although after continual adverse winds we were left with but 1½ tons of coal. Our bilge pump broke down shortly before getting in, necessitating a few days' detention, and the water tanks had also sprung leaks. As soon as we got under weigh again we had not steamed 12 hours when a hurricane struck us and we had to turn back to repair a water cock which was letting in a big volume of water. After having made good we now set out for the longest portion of the trip to Bermuda, but persistent head winds impeded us again and again until matters began to assume a serious aspect, as our coal supply was based on the assumption of making a speed of at least five knots, whereas it seemed that at times we were not making three. We were about 350 miles from Bermuda when we were compelled to reduce speed and economize to the utmost. We accordingly sealed up one furnace, and even so, unless the winds changed, we could not possibly reach our destination on the coal that was left.

This eventually gave out, and the last ton or two was employed to maintain steam for pumping only. We were now drifting with the wind away from the track of shipping and to the southeast with a sea anchor out. We stripped the bunkers of all the floor boards and all available woodwork. Our stores were giving out, our fresh-water tank had got impregnated with sea water and for the last twenty-four hours we were in a sinking condition. To make matters worse, we had to resort to bailing out water by buckets, hand over hand, up the ladders. Our meals consisted of two sea biscuits and a few sardines. At night we burned flare lights as distress signals, and it was about 1:30 A. M. on the second night of drifting that, to our intense relief, our lights were observed by

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a big steamer whose light loomed up in the distance, and on getting nearer we could discern four funnels.

She proved to be the U. S. S. fast cruiser *Birmingham,* which had made a detour much to the eastward of what was a direct course from Savannah to Hampton Roads. A welcome inquiry through the megaphone from the captain as to whether we needed assistance was answered in the affirmative, and he replied that he would send a lifeboat off at daylight. Meanwhile a powerful searchlight was directed on to us while she circled around us in wide sweeps. Oh, the exquisite pleasure of the occasion! Hardly could Paradise be more pleasurable than the state of our feelings, and if we did not cry with joy, we nearly did so. To tell the truth, our senses were somewhat numbed by the privations we had gone through.

The officers and men of the cruiser could not have treated us more kindly nor done more for us. As our craft was in a sinking condition, they fired a few shots into her before parting. This started the black cat, which formed one of our crew, and she became one of the cruiser's pets. We were taken to Norfolk, Va., and sent home by the British consul. S. E.

Victoria, B. C.

Failure of Condenser Head

Several years ago a curious accident occurred to an auxiliary condenser on one of our battleships. The sketch below shows diagrammatically the condenser with tandem circulating and air pumps. Two such condensers were carried, one in a separate compartment forward of the boiler rooms, the other in the port engine room. Ordinarily only one was kept running to handle the auxiliary exhaust and discharge from traps and drains.

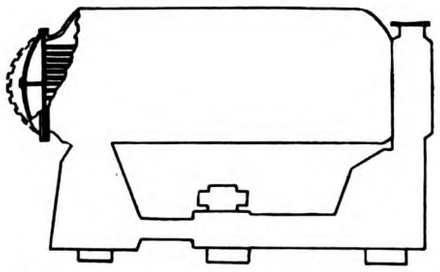

Diagram Showing Failure of Condenser Head

The forward condenser had been running all day and was shut down at 5 o'clock in the afternoon, the after one being started at the same time. The machinist's mate, who shut down the forward condenser carelessly failed to close the valve from the drain line. Of course hot water and steam from the drain line continued to empty into the condenser and must have caused it to heat up considerably.

At about half past seven o'clock that night it was desired to again start up the forward condenser. Accordingly, an oiler was sent to look after the job. He later stated on oath that he had opened the sea discharge before starting the circulating pump, and his statement was corroborated by men working in the adjoining boiler room. He did not, however, take the precaution to feel the condenser.

As soon as steam was turned on the pump it started with a bang. The cold water, coming in contact with the hot condenser tubes, formed steam and caused water hammer. Such a great pressure was created in the condenser that the pump had not made more than two strokes before the end of the bolt supporting the center of the condenser head flew off, and the condenser head itself was bulged out about six inches and cracked in the middle. The dotted lines on the figure show approximately the shape into which it was forced.

After the accident a careful examination of the damaged condenser showed no deterioration in the metal which might account for the failure. A board appointed to investigate the cause of the accident reached the conclusion that, although the sea discharge was open, the steam formed in the condenser when the pump was started caused water hammer and sufficiently high-pressure to break the bolt and distort the condenser head. H.

An Unexploded Boiler

Figs. 1 and 2 show very graphically to what extent a neglected boiler can be affected by corrosion both internally and externally. These photographs show a small Scotch marine boiler, 5 feet in diameter, 5 feet long, built

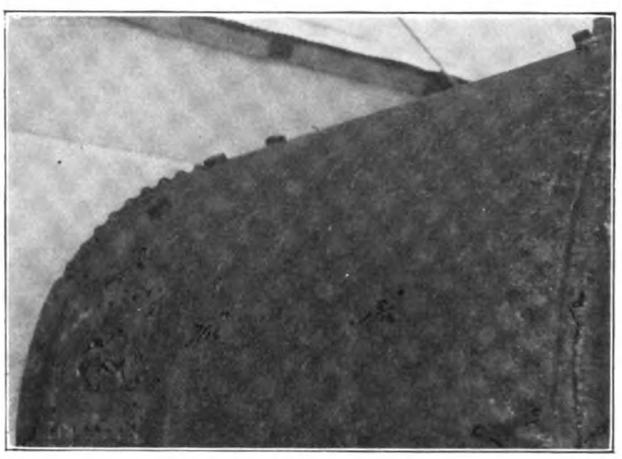

Fig. 1

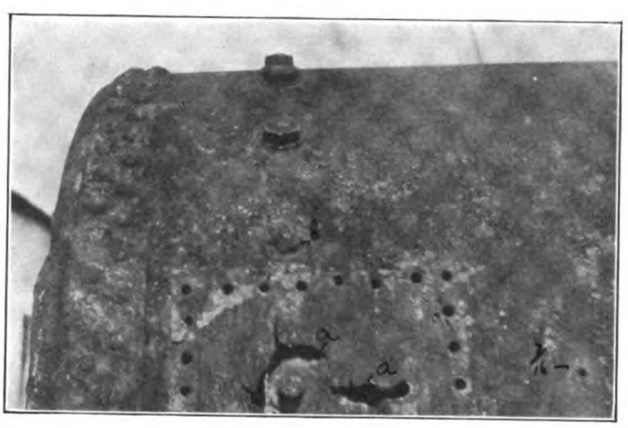

Fig. 2

with shell plates originally ½ inch thick. The boiler was built some fourteen years ago in Hongkong, China, and installed in a small harbor launch.

On the last annual inspection of this launch the Government inspector of boilers recommended her owner to have the boiler unshipped, so as to enable him to make a survey as complete as the size of the boiler would permit.

When landed ashore the external surface of the bottom of the shell and the lower parts of the front and rear head

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plates were found covered with a layer of rust nearly ¼ inch thick; a soft patch made of an iron sheet ¼-inch thick, and fitted with ½-inch bolts, was seen also in the place indicated on both photographs. This patch was removed, the rust chipped off, and two test holes drilled in the shell, all the order of the inspector, after which the following defects, all shown in the photographs, were discovered:

Several big irregular-shaped holes (*a*, Figs. 1 and 2) on the patched part of the shell; these holes, it may be presumed without fear of contradiction, did not exist at the time the patch was fitted, or, if they existed, they were not so large, otherwise a stronger patch would have been made than the one removed. Also the existence of these holes may be attributed mostly to internal corrosion caused by the accumulation of scale on the water leg under the combustion chamber.

The thickness of the shell plate found at the test holes was as marked on Fig. 1, showing a minimum reduction of 12 percent and a maximum of 62 percent in the original thickness of the plate. Most of this reduction could be caused only by external corrosion, which is shown also on the nearly wasted away staybolt nut above the patch (*b*, Fig. 1); on the front girth seam, where the thickness of the shell plate was in some places reduced to less than 1/16 of an inch (*c*, Fig. 1); and on several rivet heads, one of the rivets having been knocked out by a few slight strokes of the inspector's hammer.

Another serious defect discovered is plainly seen in Fig. 1 at *d*. It is a crack about 18 inches long on the front head under the furnace, where the plate is flanged to join with the shell.

Notwithstanding all the above-mentioned dangerous defects this boiler, according to the engineer in charge, showed scarcely any leakage, and the writer easily believes this on account of the large quantity of incrustation found inside the boiler. This was so great that in some places, like the water leg under the combustion chamber already mentioned, and under the furnace where the crack is seen, the scale formed a solid block between plate and plate.

Why this boiler never exploded is a cause for wonder, but the moral is that all boilers which are so placed on board ships that proper care can not be taken of them, and that an inspection of the shell can be made with extreme difficulty, if at all, should be lifted from their seats once in a while, at least once in every four years, to allow a good cleaning and inspection of the boiler, as well as that part of the hull which is directly underneath the boilers. This the British Board of Trade requires in its regulations for the survey of passenger steamships. AUG. SUZARA.

Performance of the Shallow-Draft Producer-Gas Barge Richmond of the Augusta-Savannah Barge Line

The tunnel stern, screw propeller river barge *Richmond*, built for the Augusta-Savannah Navigation Company, Augusta, Ga., for service on the Savannah river, has been in continual service since January 28, with the exception of a few days, which were spent in making some adjustments found necessary after the first few runs. The barge, which was described in our November, 1914, issue, is 150 feet long, 5 feet deep, 30 feet beam, with a cargo capacity of 300 gross tons. It is propelled by twin-screws driven by two 75-horsepower, 3-cylinder gas engines, built by the Wolverine Motor Works, Bridgeport, Conn., which are supplied with gas by a Galusha suction gas producer, furnished by A. L. Galusha & Company, Boston, Mass.

The usual up-stream run takes from 48 to 60 hours, depending upon the load and condition of the river. During this time the engines are continually in service,

Shallow-Draft Producer-Gas River Barge *Richmond*

and according to reports from the owners there is every indication that the producer can supply gas practically indefinitely. The boat is required to do considerable work around the harbor in Savannah, and this service has been satisfactorily performed. The coal consumption has varied some, but the best run up-stream has shown a coal consumption of about 1.22 pounds per horsepower hour. When running the producer is charged once every three hous, so that the labor involved is very small.

The general performance of the boat has been such as to indicate that the tunnel stern, screw propeller type of barge is admirably suited to the kind of service which this boat has to perform. Navigation of the Savannah river is over a very crooked channel, which is subject to sudden freshets, with correspondingly high currents and with very difficult and sudden bends, which make the thorough control of the boat a matter of great importance both up-stream and downstream. The stern-wheel boats, which formerly were used on this river, found it necessary when going downstream to navigate the bends in the river by stopping, backing and straightening out. With the *Richmond*, however, it has been found possible to steer straight around even the worst bends.

According to statements by the general manager of the barge line, this vessel, with its steel hull and steel cargo house, has not only given satisfactory service, but it has appealed very strongly to insurance interests, with the result that excellent insurance rates have been obtained, both on the hull and on the cargo. A second barge of the same type will soon be in operation.

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Marine Articles in the Engineering Press

Performance of Motor Ships—Experiments with Counter and Reversible Propellers—New Types of Ship Construction

Nobel Marine Diesel Engine of Medium Size.—This is the description of a type of Diesel engine of three, four or six cylinders in powers of 100 to 400 brake horsepower, running at speeds from 240 to 380 revolutions per minute, according to type of mercantile or naval vessel as built by Ludwig Nobel, Petrograd. It is stated that they are installed in a half-dozen tugs on the river Volga, also in some on the Vistula and Neva—a total of 32. A full enumeration and description of the details of the engine is given regarding framng, shafting, cylinders, coupling, flywheel, valve gear, reverse, separate oil pumps, valves, injection needles and setting of reversing cams and levers. The oil consumption is given as 0.45 pound per brake horsepower for fuel and 0.006 pounds for lubrication. An account is given of an installation on a sidewheel river tug where two engines deliver their power to the wheel shaft by two pairs of 1 to 6 herringbone gears. 2 illustrations. 1,400 words.—*Schiffbau*, March 24.

Systematic Model Experiments on Tugs with Wagner Counter Propellers.—An account is given of investigations by the staff of the German Government model tank in Berlin on the efficiency of the Wagner counter propeller applied to tugboats. It was shown that quite perceptible economies up to 10 percent could be realized in this type, where large slips under heavy thrusts gave the guide vanes opportunity to deflect tangential stream lines into axial ones. Three propellers and two counter propellers were the subjects of the tests, the representative features of the wheels being determined alone and afterwards with the counter propellers. Experiments are recorded also on the influence of screws with and without counter propellers upon the bottom of canals. The corresponding erosions and sand displacements were practically only one-half where counter propellers were fitted as against cases where the wheel ran alone. An appendix is given on the theory of the propeller, giving formulas for thrust, slip, speed and horsepowers. 20 illustrations and diagrams. 8 tables. 2,600 words.—*Zeitschrift des Vereines Deutscher Ingenieure*, April 24.

The Burmeister & Wain Oil Engine.—Thirteen first class vessels, equipped with four-stroke Burmeister & Wain Diesel marine engines, are now in service, including the motor ship *Mississippi*, which is described in detail in this article. The main partculars of these vessels with the performance of the machinery are tabulated, showing the trial horsepower of the engines and the fuel consumption. The motor ship *Mississippi*, built on the Clyde, is equipped with two six-cylinder engines designed to develop 1,600 indicated horsepower each at 110 revolutions per minute. The cylinders are 27.1 inches diameter and 40.55 inches stroke. 20 illustrations. 5,250 words.—*Engineering*, February 19.

Warships of the Future.—In discussing the development of warships up to the present time, it is shown how the progress of the combative qualities of such vessels has been founded on theory in place of the trial-and-error methods which are the foundation of nearly all other mechanical engineering progress. The present war, however, has shown that, while with the type of development previously adopted, above-water attack is not dreaded, nevertheless it is the continual menace of the mine and under-water attack which controls the movements of all fleets in actual war. It is predicted that the first nation that can combine with the present type of over-water design, the merits of which have been demonstrated beyond the shadow of doubt, invulnerability below water, will have the mastery of the seas at her disposal. Such is the problem for the future. The author seems convinced that the torpedo in battleships and battle cruisers will be likely to be discarded. It is also suggested that for the destruction of submarines, the ram may be found useful, if not on regular ships of the line, at least in special ram vessels. 1,550 words.—*The Engineer*, April 9.

The Cylindrical Tank Oil-Carrying Steamer Ricardo A. Mestres.—In this vessel, constructed by Messrs. William Gray & Company, Ltd., of West Hartlepool, the oil, instead of being carried in ordinary holds with straight bulkheads, is contained in large cylindrical tanks, so that there is a freedom from webs and stiffeners on the internal surface, the consequence being that the process of cleansing is greatly expedited and more effective. The tanks are of sufficient capacity to take the full deadweight load of heavy oil and ordinary cargo or light oil can be shipped in the spaces between the outer walls of the cylindrical tanks and the sides of the ship, the space being divided up into a number of compartments by watertight bulkheads. The vessel has a length between perpendiculars of 365 feet, a beam of 50 feet 9 inches and a molded depth of 29 feet 3 inches. The total capacity of the cargo spaces is 285,793 cubic feet. There is also a bunker capacity of 26,183 cubic feet. Propulsion is by single screw triple expansion engines with cylinders 25, 51 and 68 inches diameter and 48 inches stroke, steam being supplied from three Scotch boilers at a pressure of 180 pounds per square inch. 11 illustrations. 1,300 words.—*Engineering*, April 16.

The Revival of the Reversible Blade Propeller.—The motor ship *Poseidon*, recently built by Smith's Dock Company, Ltd., of Southbank-on-Tees, for the Anglo-Saxon Petroleum Company, Ltd., the owners of the *Vulcanus*, *Juno*, and other interesting motor ships, is fitted with a 450 indicated horsepower Werkspoor Diesel engine, built by the Nederlandsche Fabriek and equipped with a three-blade reversible propeller. The actual swiveling of the blades in the boss is said to be a fairly simple matter, and is fully illustrated and described. The method of operating the control rod in the tail shaft, however, is not so simple, in view of the fact that connection has to be made from a stationary part to a revolving part, requiring great rigidity and strength throughout. The apparatus for accomplishing this purpose is described and the whole arrangement is compared with a similar arrangement where the Diesel engine itself is reversible. Many advantages are claimed for a power plant in which the engine itself is non-reversible, and the astern motion is obtained by reversing the blades of the propeller as compared with a plan where the Diesel engine itself must be made reversible. The superiority of one scheme over the other for small powers seems to be in doubt, while for large powers the reversible propeller has not yet been tried out. 6 illustrations. 3,000 words.—*The Engineer*, March 26.

The Performance of Motor Ships.—In reply to points raised in a previous article, discussing a report made by the chief engineer of Messrs. Burmeister & Wain, comparing the performance of steam and motor ships on simi-

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lar voyages, Messrs. Burmeister & Wain have presented evidence showing first, the reason why it took a motor ship nineteen days longer to accomplish a journey of only ten miles more than that of a steamship, even though her speed was slightly greater than that of the steamship. The motor ship was delayed in harbor for loading and discharging cargo at the time harbor laborers were on a strike. The delays were due in no way to faults in the propelling machinery. The two other points raised related to repairs and overhaul of the machinery. The evidence brought forward shows that the total repairs, after extended voyages, were very slight indeed, and the cost of maintenance comparatively low. A detailed account of the exact repairs found necessary is given, and there can be no dispute as to the accuracy of the data. The total cost of repairs to the engines of the motor ship *Siam*, after her first voyage, which covered nearly 28,000 miles, was only $312.20 (£63 19s. 10d.). At the end of the second voyage, the cost of repairs amounted to $762.40 (£156 4s. 8d.). Some of the items enumerated could very properly be eliminated, as they are not directly chargeable to the engines, and, making these deductions, the cost of repairs for the first voyage would be reduced to $215.60 (£44 3s. 8d.). 2,400 words.—*The Engineer*, April 2.

The Works of Canadian Vickers, Ltd., at Montreal.—The passage by the Canadian parliament of the Dry Dock Act of 1910, providing for subsidizing ship repairing establishments in the Dominion of Canada, led to the establishment of the Canadian Vickers Works at Montreal. The construction of the establishment was begun in May, 1910, at a point where the St. Lawrence River has a width of over a mile, and the deep water channel has a minimum depth of 35 feet. The site reclaimed for the yard has a total area of 30 acres, and is triangular, projecting into the river, so that vessels leaving or entering the basin are required to be slewed only to a slight angle with the main line of the channel. The main basin has a width of 500 feet and a length of 1,000 feet. At the inner end of the basin are the building berths, and in way of the berths special precautions have been made to exclude the winter floods by means of portable cofferdams incorporated with the structure of the building shed itself. The first part of the scheme, the provision of a floating ship dry dock to meet the requirements of the Act, was completed in the autumn of 1912, the dock being constructed by the Barrow Works of Vickers, Ltd., the lifting capacity being 25,000 tons. At the same time, there was completed at the Works a ship-repairing plant comprising blacksmith, engine and boiler shops and foundry. A floating crane is also provided which has a capacity of 75 tons at 51 feet radius, with a lifting speed of 3 feet per minute; 60 tons at 66 feet radius with a lifting speed of 3 feet per minute, and 10 tons at 72 feet radius with a lifting speed of 20 feet per minute. After providing for a repairing establishment, a further development was carried out, resulting in an extensive shipbuilding establishment. The width of the shipbuilding berth is 105 feet and it is entirely closed in, so that work can proceed independently of the weather. The iron workers' shed forms a continuation of the shipbuilding berth, and, with this arrangement, it is possible to build vessels up to 1,000 feet in length. Outside of the shipbuilding shed are open berths with an available width of 250 feet. A detailed description is given of the various shops and machinery, power plant and other equipment. 14 illustrations. 5,300 words.—*Engineering*, February 5.

The Diesel Engine.—By Herr Prof. Dr. Ing. Paul Rieppel. A paper prepared for the Connecticut branch of the American Society of Marine Draftsmen and translated by Mr. A. B. Lakey. Although the ideas which first gave an impetus to the development of the Diesel engine were originally enunciated about twenty-two years ago, it required years of experiment and research before a practical engine, operating on the Diesel cycle, was put into actual use. In describing the working cycle and details of construction of the marine four-cycle Diesel engine, the author uses the type manufactured by the Maschinenfabrik Augsburg-Nürnberg as an illustration. A comparison is then made of various types, pointing out the special features of high speed engines, the two-cycle engine and the double-acting engine. A summary is given of the advantages of the Diesel engine, especially as to its economy and its adaptability to the use of various fuels. 5 illustrations. 6,000 words.—*The Journal of the American Society of Marine Draftsmen*, January and April.

The Submarine.—By C. A. Ward, Jr. The standard types of submarine boats, known as the Holland, Laubeuf, Krupp and Laurenti types, are illustrated and described in detail, showing the relative advantages of each type as regards stability, speed, sea-going qualities and cruising radius. The requirements and desirable qualities for a modern submarine of, say, 600 tons displacement, are summed up as follows: Speed, surface, say 18 knots; speed, submerged, 10.5 knots for one hour, 9 knots for three hours; radius of action on the surface, at least 2,000 miles, submerged 30 miles; reserve buoyancy, 25 to 40 percent of surface displacement; metacentric height, surface conditions, say 30 inches, submerged, 12 inches; hull to stand submersion to a depth of 200 feet, with a factor of safety of at least 2; ample safety arrangements, including drop keel, telephone buoy, submarine signal sending and receiving apparatus, lifting rings for wrecking operations, searchlight, etc. While Russia is building submarines 250 feet long with a submerged displacement of 1,000 tons and boats as large as 1,200 tons are under construction, nevertheless it is unlikely to look for surface speeds in any way comparable to those of the surface torpedo boats, because such a relatively small proportion of the submarine's weight goes into machinery for surface propulsion. In a modern heavy oil engined submarine of about 430 tons surface displacement, the proportion of weight taken by various items would be about as follows: Hull structure, 35 percent; storage batteries, motors, wiring, etc., 29 percent; oil engines and fuel, 15 percent (engines only, 7½ percent); pumps and piping, compressors, air flasks, etc., 8 percent; torpedoes and tubes, 4 percent; ballast and miscellaneous, 9 percent. This is for a boat of 14 knots speed with a radius of action of 1,500 miles at full speed or 2,300 miles at 11 knots. The engines are of 1,200 horsepower at 450 revolutions per minute. The reserve buoyancy is 45 percent of the surface displacement. Comparing this with a fairly modern torpedo boat such as the *Paul Jones*, with watertube boilers, coal fired, and reciprocating engines of 8,000 indicated horsepower, having a displacement of 470 tons and a speed of 28 knots, it is found that the machinery weighs 200 tons and the fuel 180 tons, making a total of 380 tons or 81 percent of her total displacement, 42 percent of this being in the propelling machinery. Comparing this with the 7½ percent for the propelling machinery of the submarine, it will be readily understood why it is impossible to get a corresponding amount of power, and therefore speed, in the submarine in which 35 to 40 percent of the weight goes into the structure and another 25 to 30 percent into the motive power for submerged running, leaving a margin of, say, 35 percent for oil engines and fuel and all other fittings. 4 illustrations. 5,500 words.—*The Journal of the American Society of Marine Draftsmen*, January.

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New Books for the Marine Engineer's Library

Elementary Books on the Steam Engine and Marine Engineering Design—Year Book of Wireless Telegraphy

HYDRAULICS, Volume II: The Resistance and Propulsion of Ships. By S. Dunkerley, D.Sc. Size, 5½ by 8½ inches. Pages, 253. New York and London: Longmans, Green & Company. Price, $3.00; 10/6 net.

Supplementing a previous volume which deals with hydraulic machinery, this book takes up the question of stream lines, waves, resistance of ships, and then discusses the theoretical conditions affecting the propulsion of ships and gives data regarding actual trials of full-sized ships. The book is a rather brief but clearly presented treatment of a subject which is usually thoroughly covered in books on naval architecture and marine engineering.

MARINE STEAM. Second Edition. Size, 7½ by 10½ inches. Pages, 220. Numerous illustrations. New York and London, 1914: The Babcock & Wilcox Company.

While this book is issued as a catalogue descriptive of the boilers manufactured by the Babcock & Wilcox Company, the engineering data given, showing the results obtained with watertube boilers in a great many different installations, are of great interest and value from an engineering standpoint. A short historical review of the development of the Babcock & Wilcox boiler is followed by a detailed description of the present types. Throughout, the modern boiler has been compared to the ideal boiler as outlined in the late Admiral Melville's list of essential characteristics. The book is very complete. It contains much accurate data that cannot be obtained elsewhere, and should have a place in every marine engineer's library on account of the extensive use of the Babcock & Wilcox boiler in marine practice.

ELEMENTARY MANUAL OF THE STEAM ENGINE. By Ernest V. Lallier. Size, 5 by 7⅝ inches. Pages, 266. Illustrations. 102. New York, 1913: D. Van Nostrand Company. Price, $2.00 net.

In order to help students of steam engineering who lack practical experience, and operating engineers who lack theoretical instruction, the author has compiled a manual which presents the fundamental principles of the use of steam and steam engines in an elementary manner. While the book was written for a special class of readers, the author's experience as an instructor in engineering has made it possible for him to accomplish his task in a very efficient manner. The subjects covered are reciprocating steam engines, governors, engine calculations, the indicator, heat, boilers, pumps, Corliss engines, pipes and fittings, rotary engines, internal combustion engines and lubrication. Numerical examples are used freely throughout the book, and at the end of each chapter are representative questions which will enable the reader to gage his knowledge of the text.

SIMPLE PROBLEMS IN MARINE ENGINEERING DESIGN. Third edition. By J. W. M. Sothern and R. M. Sothern. Size, 5 by 7½ inches. Pages, 191. New York, 1914: D. Van Nostrand Company. Glasgow, 1914: James Munro & Company, Ltd. Price, $1.00 net.

The subject-matter in this book is divided into six sections: the first, giving instructions in simple mathematics: the second, general problems showing the application of elementary mathematics; and then four sections dealing with actual marine engineering problems. Section 3 contains problems on boiler design, section 4 on engine design, section 5 on speed, consumption and indicated horsepower and section 6 on marine turbine design. In each section the rules used in solving the problems are given together with examples, and then in each case a number of problems with the answers given below, leaving the students to work out the problems themselves, so that the results can be checked up with the correct answers given in the book. The book will be found very useful for self-instruction, as the problems are simple and cover a wide range of subjects relating to marine engineering design.

GRAPHIC METHODS FOR PRESENTING FACTS. By Willard C. Brinton. Size, 7 by 10 inches. Pages, 371. Illustrations, 255. New York, 1914: The Engineering Magazine Company. Price, $4.00.

Anyone who may have occasional charts to prepare for reports, for magazine illustration, or for advertising, will find this work a very useful handbook, as the great variety of methods for presenting facts graphically which are given cover almost any arrangement which may be necessary. Furthermore, the right and wrong methods of presenting facts graphically are fully illustrated. The subject is treated in simple language and the contents have been carefully arranged, so that any part of the work is immediately accessible for any desired purpose.

ELEMENTARY SEAMANSHIP AND PLAN FOR NAUTICAL TROOPS BOY SCOUTS OF AMERICA. Compiled by Charles Longstreth. Size, 5 by 7 inches. Pages, 120. Numerous illustrations. New York, 1915: National Headquarters of Boy Scouts of America. Price, 25 cents.

The plan adopted for handling nautical troops of Boy Scouts of America is to use a houseboat with several small boats, suitable for both rowing and sailing. With such an equipment from 100 to 200 boys per season can receive instruction, provided the proper scout masters are available. The principal idea of this scheme is to teach the scout systematic methods that have been handed down for generations where space, water, etc., have had to be conserved in order to make life afloat possible. This pamphlet describes the organization, equipment and routine work of the Nautical Boy Scouts, gives instructions for tying knots, handling tackles, sailing small boats, handling boats in a surf, the use of the compass, the lead, and the chart and outlines the rules of the road. At the end of the book are the international rules and inland and pilot rules. While seamanship cannot be learned from books, nevertheless the information given in this pamphlet will be found extremely useful to the novice.

THE YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1915. Size, 5½ by 8¼ inches. Pages, over 800. London, 1915: The Marconi Press, Limited. Price, 2/6 net.

A study of the 1915 issue of the "Year-Book of Wireless Telegraphy and Telephony" indicates very forcibly the immense progress that has been made in the extension and development of this form of communication during the last twelve months. The new volume serves not only as an admirable book of reference for all who have to do with the subject either in its commercial application or in the field of research, but also includes a complete historical résumé of the development of etheric wave telegraphy from its inception to the present day. All of us like to know something about the main factors which play their part in modern life, and some of us like to penetrate a little further into the mysteries, while others again already well informed are anxious to keep abreast of the latest developments. All three classes will find in the "Year Book of Wireless Telegraphy" exactly what they require.

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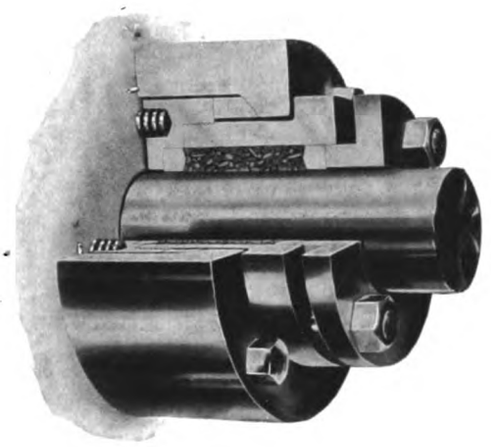
ENGINEERING SPECIALTIES

Vibrating Stuffing Box

A vibrating stuffing box for marine engines, air compressors, steam pumps, valves, etc., which automatically adjusts itself in an out-of-line movement of the piston rod or stem, is manufactured by the Steel Mill Packing Company, Detroit, Mich., and marketed by Munro & Windas, 50 Church street, New York. As shown by the illustration, the flexibility of this stuffing box is obtained by a ball joint working in connection with the sliding face of a flange on the stuffing box. The ball joint is kept tight and free from leakage by the steam pressure and is held



Part Section of Stuffing Box

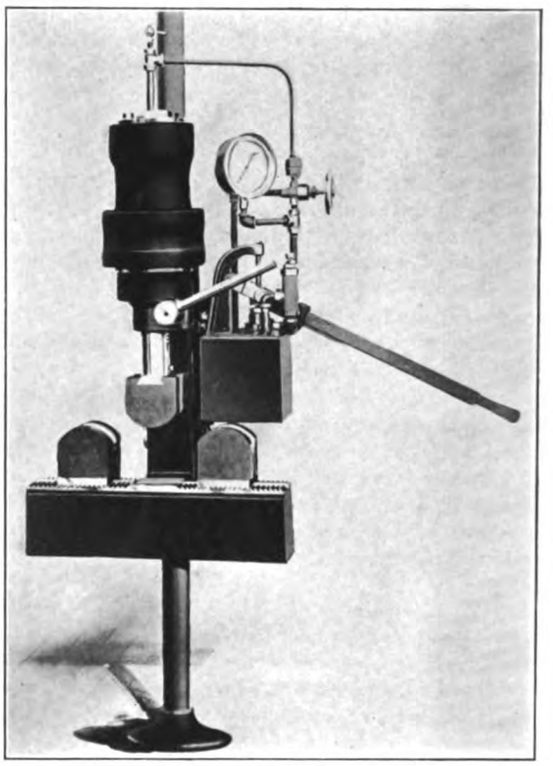
in place when the steam is turned off by the pressure exerted by small springs inserted between the cylinder head and the stuffing box. Spacing rings at each end of the packing work in connection with the packing holding the stuffing box out of contact with the piston rod, thus preventing wear. The spacing rings are made in halves, and, when necessary they can be easily replaced at small expense. Any suitable packing can be used in this stuffing box.

30-Ton Hydraulic Pipe Bender

Originally designed for bending pipe of various sizes, the press shown in the illustration is also adaptable for miscellaneous bending work which comes up in machine shops, such as bending and straightening axles, small structural shapes, bars, shafts, etc. By the use of bending blocks, pipe up to 4 inches in diameter can be bent. Clamps are provided for attaching the press to a stanchion, which has a maximum diameter of 5 inches.

The construction of the press is of steel throughout. The "C" frame and bending bed are cast in one piece. The top of the "C" frame is provided with a ring into which the cylinder sets. When the cylinder is received into this ring and turned to its desired position it is keyed into place. An advantage is claimed in having the cylinder set in a ring in this manner, because it can be placed in any position desired, bringing the handle of the rack and pinion to any point which is most convenient to the operator. Another advantageous feature is the fact that the bending blocks are changed without the use of wrenches, screws, etc.

The ram of this press is forced downward by a hand-operated pump, which has a plunger diameter of 5/8 inch and a stroke of 3½ inches. The pump is equipped with a ½-inch safety valve and ½-inch tee wheel operating valve. The reservoir is a part of the pump. A hand-operated pump is more desirable on a hydraulic press of this kind, it is claimed, because there is no danger of over-bending the pipe or other material. By the use of hand power a rapid movement of the ram may be obtained at the start when it is most desirable and when the bend has almost reached the predetermined point any desired speed of the ram can be developed. In this way just the character of bend which is wanted can be produced. The rack and pinion is provided for the rapid movement of the ram to the work before the pump is operated. The downward movement of the ram fills the cylinder with



Hydraulic Bending Press

fluid and the upward movement returns the fluid to the water box. In this manner there is no lost motion in the operation of the pump. A maximum pressure of 30 tons is developed on the press.

The ram has a diameter of 6 inches and a run of 9 inches. The pressing bed which receives the bending blocks is 27 inches long with a pressing width of 8 inches. When the ram is returned the distance from the top of the cylinder to the head of ram is 24½ inches. The distance between the ram head and the pressure bed is 14¼ inches. The height of the press overall is 3 feet 11 inches.

This press is a new design recently developed and added to the line of hydraulic machine tools manufactured by the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio.

Heavy Gate Shear

The new heavy gate shear illustrated, which has recently been designed and built by Bertsch & Co., Cambridge City, Ind., has 72-inch blades and a capacity for cutting 1¼-inch plates the full length of the machine. It is of extra heavy construction throughout and all gears, shafts and bearings are of liberal proportions. The ma-

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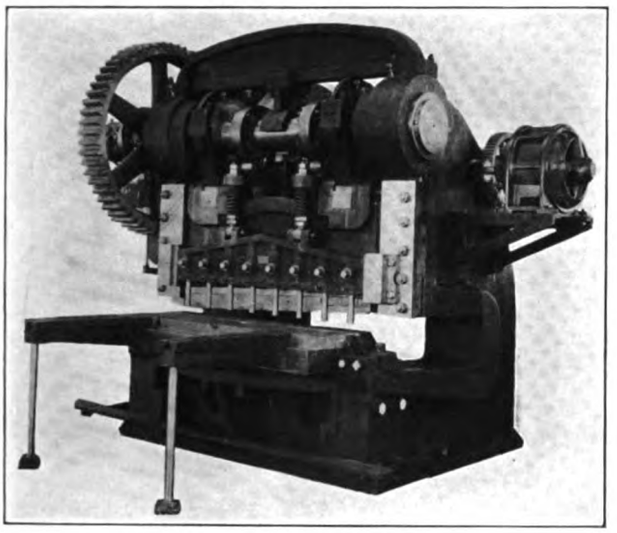
chine is held together rigidly by means of a bed, a cross-tie piece in the rear of the gate and a cross-tie piece overhead, all substantially bolted to the housings. An important feature of the machine is a new toggle joint clutch, for which the builder is applying for a patent. This clutch, it is claimed, is positive, noiseless and automatic.



Bertsch G ate Shear

It is actuated by means of the well-known toggle joint principle, which increases the engaging pressure against it as it engages, thereby insuring full contact of the jaws. It is disengaged by means of a hardened steel roller acting against a renewable cast steel switch ring or sleeve.

Two Handy Tools

The tools illustrated in Figs. 1 and 2 are the first of a line of small, moderately priced tools for mechanics to be put on the market by W. D. Forbes, New London, Conn. Fig. 1 shows in full size a center punch which is carefully made with both ends hardened. As the material is of the best and the workmanship accurate, this center punch will be found to be all that a center punch should be.

In Fig. 2 is illustrated a surface gage which stands 9 inches high and has a base of 2¼ inches by 2¼ inches. The needle is 9 inches long. Vertical adjustment is quickly made either by sliding the arm carrying the beam up and down on the column, or by tilting the beam which carries the needle on the arm. Micrometer adjustment of the needle is obtained by turning the knurled nut which is fitted into the jaws of the beam.

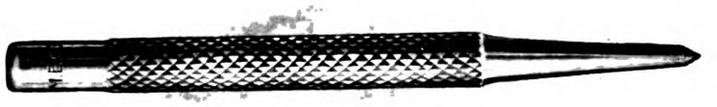


Fig. 1.—Center Punch

New Style Riveting Hammer

George Oldham & Son Company, Frankford, Philadelphia, Pa., has placed on the market a new style riveting hammer which is built in three sizes, 6, 8 and 9 inches. This hammer is a radical departure in construction from the old type riveting hammers manufactured by this company. It embodies many novel features, conspicuous among which is the method of clamping the handle which prevents it from coming loose. As can be seen from the illustration, springs are used to absorb the shock from the blows of the hammer, so there is comparatively little reaction, thus minimizing the strains on the more vital parts of the hammer. With the old style rigid construction with threads on the cylinder engaging those on the handle, there was danger of the threads stripping, whereas in the new style tool the full shock of the hammer blows is absorbed by the springs. The throttle construction of the new style hammer is also a decided improvement, increasing, it is claimed, the efficiency of the hammer, and reducing to a minimum the possibility of leakage. Although 1½ pounds lighter than the average hammer of corresponding piston stroke, nevertheless it is claimed that this tool is just as powerful and fast and much more durable.

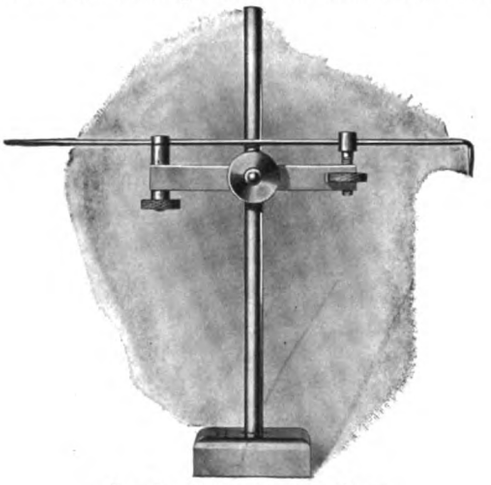
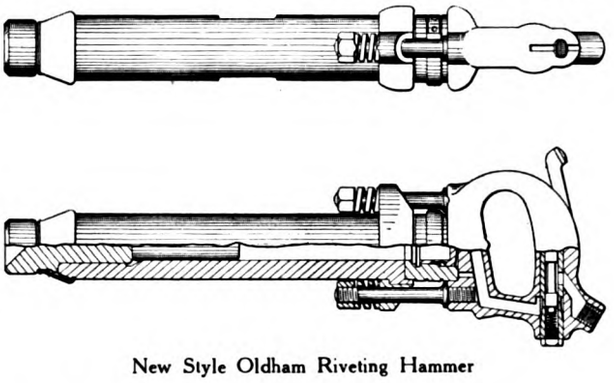


Fig. 2.—Forbes Surface Gage



New Style Oldham Riveting Hammer

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"Re-New-Volute" Centrifugal Dredging Pump

The illustrations show plans for a "Re-New-Volute" centrifugal dredging pump, designed by H. S. New, 90 West street, New York. The object of this design is to

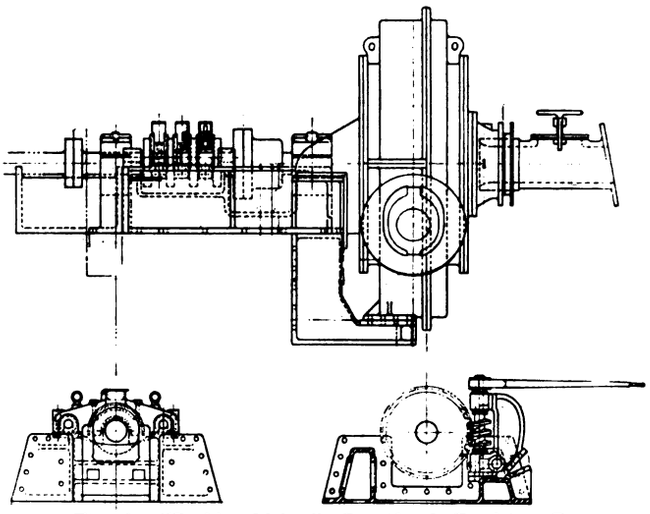

Fig. 1.—"Re-New-Volute" Centrifugal Dredging Pump

provide a single pump casing inclosing a lining of extreme thickness where required, variable in form within limits, simple to cast and requiring a minimum of machine work. In the design shown three sizes can be adapted to one cas-

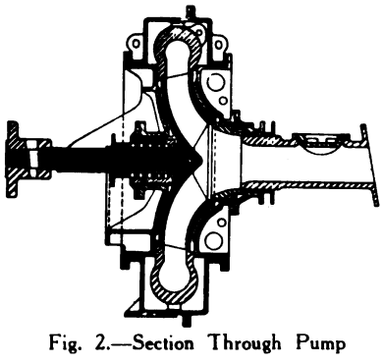

Fig. 2.—Section Through Pump

ing, with the added feature that the volute lining may be made of metal, concrete, hard wood or other material to suit the conditions met. The pump, therefore, is adapted not only for dredging, but also for handling coal, tailings, etc., at smelters, or material containing a large percentage of corrosive acids.

BUSINESS ANNOUNCEMENT.—The Vulcan Iron Works, Inc., of which A. J. Grymes is president and L. S. Parker vice-president, acquired on May 1 the entire plant and business of Alex. Miller & Bro., Inc., at the foot of Morris street, Jersey City, N. J., and is prepared to do all classes of boiler and machine work and repairs to steel and wooden vessels.

INTERNATIONAL CONGRESS OF NAVIGATION POSTPONED.—The thirteenth annual meeting of the International Congress of Navigation, which was to have been held at Stockholm, Sweden, during the present year, has been postponed indefinitely.

LECTURE ON ORGANIZATION.—Homer L. Ferguson, general manager of the Newport News Shipbuilding & Dry Dock Company, addressed the Newport News branch of the American Society of Marine Draftsmen recently, discussing the subject of organization as applied to shipyard management.

PERSONAL MENTION

Operating Engineers

Joseph Covert, of New Orleans, La., has been appointed first assistant engineer of the steamship *Harwood*.

A. J. McMillian, of New Orleans, La., has been appointed third assistant engineer of the steamship *Coppername*.

Thomas J. Holmes, Jr., of New Orleans, La., has been appointed second assistant engineer of the steamship *Panuco*.

Allard Jones, of Paducah, Ky., has been appointed second engineer on the river steamer *Reaper*, vice Harry Voight, resigned.

Matthew McCormack has been appointed chief engineer of the steamer *William H. Frear*, of the Troy and Albany Line, Albany, N. Y.

George Armshaw, of New Orleans, La., formerly of the steamship *Mexicana*, has been appointed chief engineer of the steamship *Panuco*.

J. S. Rankin, of New Orleans, La., formerly chief engineer of the steamship *Panuco*, has resigned to take up work in New York City.

William van Hoesen, of Albany, N. Y., formerly a river engineer, is acting as assistant engineer for the Great Lakes Dredge & Dock Company.

William Pratt, formerly chief engineer of the tug *Charles C. Wing*, has been appointed chief engineer of the tug *Eugenia*, at Waterford, N. Y.

John Butler, of New Haven, Conn., formerly with the Winchester Arms Company, has accepted a position as chief engineer of the steamer *Smith Bros.*

William Ferris, of Cleveland, Ohio, has been appointed first assistant engineer of the tug *M. A. Knapp*, which is handling tows between Troy, N. Y., and Bogart Island.

Willard Spencer has been appointed chief engineer of the steamer *G. V. S. Quackenbush*, of the Troy and Albany Line, Albany, N. Y., which opened the season on May 15.

J. W. Rowland, formerly chief engineer of the steamer *Smith Bros.*, has been appointed chief engineer of the *J. P. Randerson*, of the New Haven Towing Company, New Haven, Conn.

Thomas Hemstock, formerly chief engineer of the *J. P. Randerson*, of the New Haven Towing Company, New Haven, Conn., has been appointed chief engineer of the steamer *Dreadnaught*, of Providence, R. I.

Charles Prescott has been appointed chief engineer of the tug *George E. Lattimer*, which will be stationed at Rexford Flats on the New York State Barge Canal. Charles Hunt will be first assistant engineer of the tug.

Oliver Lang, formerly chief engineer of the steamship *Ohio* at Duluth, Minn., has been appointed chief engineer of the giant suction dredge *Massachusetts*, of the Great Lakes Dredge & Dock Company, which will be stationed at Bogart Island, above Albany, N. Y.

Charles Coggswell, of Washington, D. C., is in charge of the engine room on the steam yacht *Roxanna*, owned by Mr. Lars Anderson. The *Roxanna*, under the command

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of Captain J. T. Golden, is now being made ready for a cruise along the New England coast.

William Kersey is chief engineer of the steam yacht *Gaivota,* owned by Mr. Dospason of New York. The yacht has been given a general overhaul preparatory for summer cruises on the Potomac River and Atlantic coast. Captain Keen is in command of the yacht.

C. J. Tennesson has been appointed chief engineer of the steamer *William Davis,* of the Peoples Line, Washington, D. C. This line has been established for freight and passenger service in opposition to the Chesapeake & Potomac Steamboat Company. Captain William Davis is in command of the steamer bearing his name.

George R. Smith, of Norfolk, Va., has been appointed chief engineer of the steamer *St. Johns,* of the Chesapeake & Potomac Steamboat Company, Washington, D. C. This vessel has just returned to Washington from Newport News, Va., after receiving new boilers and a general overhauling. She will be placed on the Colonial Beach route with Captain Chap Slye in command.

R. Reed and R. Harrison are chief engineers of the double crew manning the Washington city fireboat *Fire Fighter,* which has just returned to her dock after a two weeks' stay at the Washington navy yard, undergoing general repairs and painting. The *Fire Fighter* is in charge of Captains J. Stulz and J. B. Reighley. James B. O'Donnell and William Glynn are the assistant engineers.

Captain Alfred H. Harcourt, in command of the steamer *Robert Fulton,* of the Hudson River Day Line, New York, celebrated the golden anniversary of his service on the Hudson River on May 22. On that day he completed fifty years in the employ of the Hudson River Day Line, and during that time has seen the equipment of the company grow from such comparatively small vessels as the *Daniel Drew* and the *Chauncey Vibbard,* which had a capacity of about 500 passengers, to the present-day steamers *Washington Irving* and *Hendrik Hudson,* which are licensed to carry 6,000 and 5,500 passengers respectively.

Naval Architects, Consulting Engineers and Shipyard Officials

H. McL. Harding, consulting engineer and specialist in the design of marine terminals and terminal equipment, has removed his office from 17 Battery Place to 52 Vanderbilt avenue, New York.

M. C. Stewart, formerly assistant steam engineer at the Cambria Steel Company, Johnstown, Pa., has been appointed mechanical engineer at the United States Naval Engineering Experiment Station, Annapolis, Md.

Professor H. A. Everett, formerly assistant professor of naval architecture at the Massachusetts Institute of Technology, Boston, Mass., has been advanced to the grade of associate professor of naval architecture at the Institute.

At the regular meeting of the Board of Directors of the Quintard Iron works, New York, held on May 18, Mr. Stevenson Taylor tendered his resignation as vice-president of the company, which was accepted by the directors with extreme regret.

F. O. Smith has been elected president, F. O. Smith, Jr., vice-president, and J. N. Smith, secretary, of the F. O. Smith Shipbuilding & Dry Dock Company, Norfolk, Va., which has recently been incorporated as successor to the firm of Smith & McCoy. Under the new management, the firm has enlarged its docking facilities and its new dry dock is now ready to haul out vessels up to the capacity of 3,000 tons.

R. R. Row and H. C. Davis, for a number of years connected with the James Reilly Supply Company and their successors, the Griscom-Spencer Company and later the Griscom-Russell Company, have resigned to take up the sales engineering of the Standard Water Systems Company, with offices at 90 West street, New York City, and factory at Hampton, N. J. This company manufactures a full line of steam specialties for marine and stationary service, including the "Standard" multicoil feed water heater, evaporator, distiller and "Tripure" aerating still.

Lawrence Bruce, for the past fourteen years chief assistant to the superintending engineer of the Anchor Line, London, has been appointed superintending engineer of the line, succeeding Mr. Walter L. C. Paterson, who retired from active service after being connected with the line for nearly fifty years, during thirty of which he held the position of superintending engineer. Mr. Bruce, the present superintending engineer, has been with the Anchor Line for a period of twenty-seven years, having served in all grades from junior engineer to chief engineer of many of the vessels of the Anchor Line fleet, and finally as assistant superintendent, supervising the construction of new vessels and repairs to the fleet.

Obituary

Charles L. Gunn, of Paducah, Ky., chief engineer of the river steamer *Egan,* was accidentally killed while on watch on his vessel on April 27.

George H. Russell, vice-president of the Great Lakes Engineering Works, Detroit, Mich., died May 17, aged sixty-seven years.

John Lee, formerly New York manager of the White Star Line and a former vice-president of the International Mercantile Marine Company, died recently at his home in Brooklyn, N. Y., aged sixty-five years.

Albert Lloyd Hopkins, president of the Newport News Shipbuilding & Dry Dock Company, was among those lost on the *Lusitania,* which was torpedoed and sunk on May 7. Mr. Hopkins was born at Glen Falls, N. Y., September 7, 1871, and in 1892 was graduated with high honors at the Rensselaer Polytechnic Institute. In the same year he was appointed to a position in the Bureau of Construction and Repair, Navy Department, Washington, D. C. Eighteen months later he became a member of the staff of Naval Constructor J. J. Woodward, U. S. N., who was the first superintending constructor assigned to duty at the works of the Newport News Shipbuilding & Dry Dock Company. In the summer of 1897, Mr. Hopkins was assigned to the Graduate School of Naval Architecture at the United States Naval Academy, Annapolis, Md., where he was an instructor and lecturer on naval architecture and ship construction. During the Spanish war he was assigned to the naval station at Key West, Fla., where he was in charge of all the construction and repair work for the blockading fleet operating in Cuban waters. While engaged in this work Mr. Hopkins received an offer from the late W. A. Post, then general superintendent of the Newport News Shipbuilding & Dry Dock Company, to act as his personal assistant at the Newport News yard. Mr. Hopkins accepted this offer and, when in 1905 Mr. Post was made general manager of the company, Mr. Hopkins was appointed assistant general manager. In 1911 Mr. Post be-

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came president of the company, on account of the death of C. B. Orcutt, and Mr. Hopkins was made manager. Upon the death of Mr. Post, in February, 1912, Mr. Hopkins was elected vice-president and became chief executive officer of the company with headquarters in New York. His election to the presidency of the company, in March, 1914, was recognized as a well-earned tribute to his ability and his devotion to the interests committed to his care. All who knew Mr. Hopkins held him in the highest esteem. Gifted with a keen mind and a strong will and personality, his education and training eminently fitted him for the position of responsibility and leadership which he filled so ably.

SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,121,563. KARL OSCAR LEON, OF NEW YORK, N. Y., ASSIGNOR TO LEON STEERING DEVICE COMPANY, OF BROOKLYN, NEW YORK, A CORPORATION OF NEW YORK. MEANS FOR AUTOMATICALLY STEERING TORPEDOES OR THE LIKE.

Claim 1.—In a torpedo, the combination of a steering device, a gyroscope connected to the said steering device so as to normally retain the course of the torpedo, receivers sensitive to vibrations of the surrounding medium, connections between the said receivers and the steering device, and means controlled by the said receivers for disconnecting the gyroscope from the steering device when a receiver is actuated. Eleven claims.

1,122,794. AUGUST T. NELSON AND CHARLES A. KLAWITER, OF MILWAUKEE, WISCONSIN, ASSIGNORS TO AUTOMATIC STEERING CO., OF MILWAUKKEE, WISCONSIN. AUTOMATIC STEERING DEVICE.

Claim 1.—An automatic steering apparatus comprising a compass-card, a contact finger carried thereby, a rotary adjustable head in axial alinement with the compass-card and above the same, a mercury-containing pot carried by the head in axial alinement with said compass-card, a downturned and extending from the contact-finger into the pot, arms carried by the head, contact members in connection with the arms for engagement with the contact-finger, means for adjusting the arms in or out with respect to the head axis, and means for spreading or contracting the arms with relation to each other. Four claims.

1,123,982. DREDGE. BENJAMIN BERNARD, OF SEATTLE, WASHINGTON.

Claim 1.—In a dredge, a ladder bracket; a bearing slidable therein; abutment members interengaged with the bracket for sliding movement; springs interposed between the abutment members and the bearing; and adjustable elements in the bracket engaging the abutment members. Three claims.

1,124,752. GOVERNOR FOR AUTOMOBILE TORPEDOES. FRANK M. LEAVITT, OF SMITHTOWN, NEW YORK, ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, N. Y., A CORPORATION OF WEST VIRGINIA.

Claim 8.—An automobile torpedo having a source of compressed fluid, an engine, and an intervening reducing valve, combined with a speed governor comprising a rotor geared to the engine, governor arms carried by said rotor and adapted to fly out under centrifugal force, a stationary member having bearings for said rotor and comprising a casing inclosing said rotor, a spring-pressed part movable in said stationary member, and connections between said part and said governor arms. Nine claims.

1,129,376. WRECK-LIFTING DEVICE. ALFRED R. BISSETT, OF VANCOUVER, BRITISH COLUMBIA, CANADA.

Claim 6.—A wreck lifting device, comprising the combination with a floatable vessel having along each side a series of flanged metal shoes each shoe curved to an ample radius and securely bedded on the deck reinforcing timbers of the vessel the shoes of one side in transverse alinement with those of the other, a windlass on each side of the middle line of the vessel between each pair of shoes, a flexible line connected to one of each pair of windlasses and passing over the shoe on the opposite side of the vessel and down to and under the submerged wreck and up and over the other shoe of each pair to the other windlass of each pair, a clamp securing each flexible line to itself where it parallels itself between the windlasses, a grooved plate between each rope and the deck timbers of the vessel and opposed wedges between the plate and the deck timbers. Seven claims.

1,129,322. HOPPER-SCREEN DEVICE. CHARLES C. WEST, OF MANITOWOC, WIS., ASSIGNOR TO MANITOWOC SHIP BUILDING AND DRY DOCK COMPANY, OF MANITOWOC, WIS., A CORPORATION OF WISCONSIN.

Claim 2.—In a sand barge of the type wherein clam shell or similar unloading devices are designed to be employed for unloading the hopper contents, the combination of the said containing hopper, means for conditioning the load therein comprising a tubular suction screening device disposed horizontally adjacent the juncture of hopper frame members, and a foraminous screening plate disposed in the path of travel of said unloading devices to extend in a protecting relation over said device and intermediately of the said frame members, said plate forming a part of said conditioning means and constructed and arranged to hold the bulk of the load away for the said device. Two claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

2,768/1914. IMPROVEMENTS IN THE LAYING OF MAGNESITE COMPOSITIONS ON SHIPS' DECKS, BULKHEADS, OR OTHER METALLIC SURFACES. H. MERRYLEES, SUTTON LODGE, CHESTER.

An improved method of laying magnesite compositions on ships' decks, bulkheads or other metallic surfaces, which consists in first covering the surface with a layer or layers of textile or the like material which is waterproofed by a thin rubber solution, and then secured to the surface, the magnesite covering being laid over the textile material.

3,262/1914. IMPROVEMENTS IN THE BEARINGS FOR THE BOTTOM TUMBLERS OR LADDER ROLLERS OF BUCKET LADDER DREDGERS. W. SIMONS & CO., LTD., LONDON WORKS, RENFREW, SCOTLAND.

The invention relates to the bearings for the bottom tumblers, or ladder rollers of bucket ladder dredgers of the type provided with means for retaining lubricant between the wearing faces and for excluding sand and water. According to the invention, a duct is provided for lubricating leading to the point of contact of a wearing plate at each end of the tumbler, revolving with the tumbler, and with a bush rotatable on the stationary tumbler shaft and a wearing plate on the bearing member carried by the ladder frame, so that the faces of these plates which take up the wear due to end thrust are efficiently lubricated.

3,995/1914. IMPROVEMENTS IN FLUID PRESSURE APPARATUS FOR OPERATING BULKHEAD AND OTHER DOORS. J. STONE & CO., LTD., DEPTFORD; F. J. PIKE AND H. NEVILLE.

Relates to fluid pressure apparatus or systems for operating bulkhead and other doors, comprising a source of fluid pressure connected with a pressure main, and door operating cylinders connected with the pressure main through respective valves, the valves being so constructed and connected up that the presence of fluid pressure in the pressure main, causes such valves to assume a position in which the pressure fluid is distributed for causing the rams to close the doors and maintain such doors in the closed position.

7,078/1914. IMPROVEMENTS IN DAVIT HEAD PINS. C. DELAHAY, 3, QUARRENDON ST., PARSON'S GREEN, LONDON.

The invention consists of a davit head pin so fitted with ball-bearings as to be non-sticking when swinging out boats at sea on board ship. The advantage of this pin is that it may be fitted to any ordinary davit by knocking out the old pin and replacing same with the new one.

7,283/1914. IMPROVEMENTS IN LOGS AND STREAM INDICATORS. W. CORNELIS, STADHOUDERSLAAM, 67, UTRECHT, HOLLAND.

This invention relates to logs and stream indicators by which jerks are imparted to a filament or wire to which a rotating member is attached. This is effected by the rotating member after a certain number of revolutions, by bringing a spring under tension and then at once releasing the spring, or by momentarily augmenting the resistance of the water. The filament wire does not rotate, but simply transfers the jerks given by the said member to the vessel, where they may be registered by a mechanism, or be felt by hand. As the jerks occur regularly after a determined number of revolutions of the rotating member the lapse of time between two successive jerks therefore indicates the rate of travel of the vessel.

8,083/1914. IMPROVEMENTS IN AND RELATING TO MACHINERY FOR THE PROPULSION OF SHIPS. W. D. McLAREN, G. M. WELSH, 124 ST. VINCENT ST., GLASGOW, SCOTLAND.

Relates to an arrangement of ship propelling machinery consisting of a reciprocating steam engine driving one propeller shaft direct, and exhausting to a high speed, low-pressure steam turbine driving another propeller shaft through the agency of a pinion and spur wheel in a known manner. The particular feature of this invention is, however, that the propeller shaft actuated by the turbine is co-axial with, and forms a sleeve on, the propeller shaft driven by the reciprocating engine and runs in a contrary direction thereto. The vessel is thus driven by adjacent propellers running in contrary directions.

14,473/1914. AN IMPROVED APPARATUS FOR SIGNALING AND RECORDING THE COURSE STEERED BY A VESSEL. R. S. O'NEIL, 39, EASTCHEAP, LONDON.

This invention relates to an improved apparatus for signaling and recording the course steered by a vessel, and has for its object to provide means whereby the position of the rudder of the vessel will be automatically signaled and the course steered by the vessel automatically recorded. The invention consists broadly in the provision of semaphore signals associated with the rudder and carrying electric lamps or other means of illumination for use at night, so arranged that when in the display position the lamps will be illuminated. The semaphore arms will be visible in daylight, and the lamps carried by them will be visible at night. The semaphore arms aforesaid are by means of suitable mechanism so associated with the rudder movements that when the position of the rudder is altered the fact will be automatically signaled. A further feature of the invention is in the provision of a recording mechanism also associated with the rudder movement which will give a graphic record of the rudder movements, and as a consequence a record of the course steered by the vessel.

2,509/1914. IMPROVEMENTS IN SUBMARINES OR SUBMERSIBLE BOATS. SWAN HUNTER & WIGAM RICHARDSON, LTD., WALLSEND SHIPYARD, WALLSEND-ON-TYNE.

Consists of a submarine having a stern provided with horizontal or diving rudder or rudders and propellers with its shafts and bearings characterized in that the propeller shaft bearings are located aft of the propeller or propellers and the propeller shaft bearing supports are used for supporting the horizontal or driving rudders.

6,891/1914. IMPROVEMENTS IN ACETYLENE GENERATORS FOR USE ON BUOYS, LIGHTSHIPS AND THE LIKE. C. W. SCOTT, LANSDOWNE BRAY, COUNTY WICKLOW, IRELAND.

According to the invention, the separate expansion chamber is cut off from communication with the external water during the time that the regular automatic action of the generator is proceeding, thereby completely eliminating any loss of illuminant due to the solution of gas in the water within these chambers, and the continual replacement of such gas-impregnated water by unimpregnated water from the outside.

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